FORT IRWIN, CALIFORNIA

TERRAIN ANALYSIS

PREPARED BY
64TH ENGINEER DET (TERRAIN) FORT HOOD, TEXAS 76544
AND
30TH ENGINEER BN (TOPO)(ARMY) FT BELVOIR, VIRGINIA 22060

UNDER THE DIRECTION OF
THE TERRAIN ANALYSIS CENTER
U.S. ARMY ENGINEER TOPOGRAPHIC LABORATORIES
FORT BELVOIR, VIRGINIA 22060

APRIL 1984
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FORT IRWIN, CALIFORNIA TERRAIN ANALYSIS

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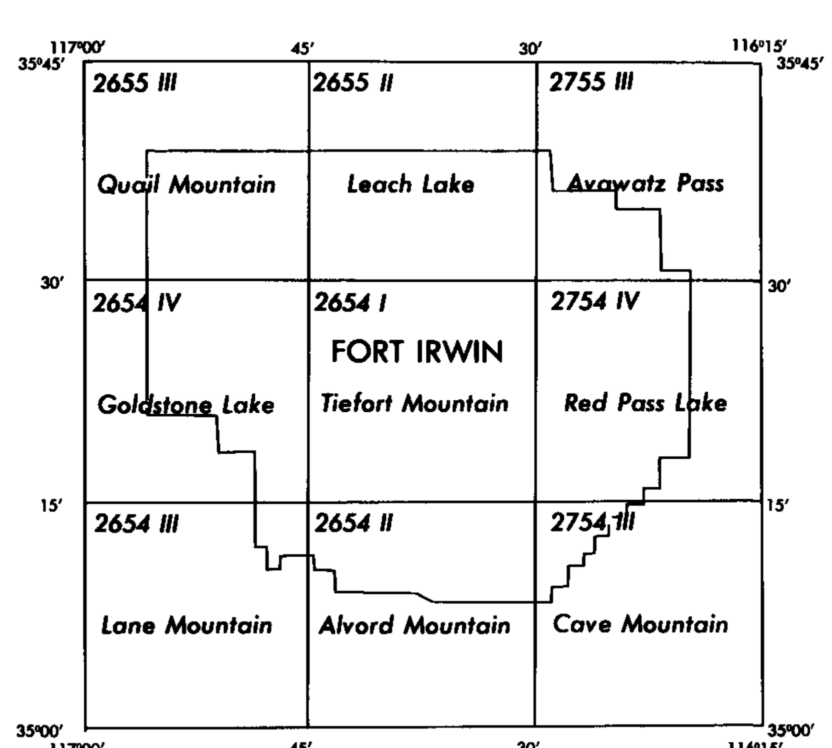

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I. INTRODUCTION

BACKGROUND

The requirement for this terrain analysis was stated in message P 241854Z Oct 75 from Commander, FORSCOM to the Office of Chief of Engineers (OCE), Department of the Army subject; "Terrain Analysis of Selected FORSCOM Installations." The message identified several installations, including Fort Irwin, and cited the topical coverage desired in the study. Headquarters, Department of the Army message A 012042Z Mar 76, assigned to the 64th Engineer Detachment (Terrain) the task of Fort Irwin terrain analysis to be completed by Dec 78. The Terrain Analysis Center (TAC) of the Engineer Topographic Laboratories (ETL), Fort Belvoir, Virginia, was tasked by OCE with management and supervision of the overall project. FORSCOM message R 051328Z Jun 78, stated the initial reassignment of cartographic and reproduction support from the 524th Engineer Company (Topo), Ft. Hood, TX to the 30th Engineer Battalion (Topo), Ft. Belvoir, VA.

The scope and content of the topical coverage of FORSCOM requirement were developed jointly between TAC and FORSCOM representatives. Analytical and cartographic specifications were developed by TAC, cooridinated with OCE, and concurred in by FORSCOM Headquarters.

PURPOSE

In stating the requirement for terrain analysis of selected installations, FORSCOM indicated that the purpose of the program is to assist military planners in future stationing decisions. To achieve this purpose, planners must obtain an appreciation of the on-post terrain that includes among many other things, knowledge of the suitability for conducting field training exercises involving maneuverability of troops and military vehicles. The degree of maneuverability that can be achieved is a function of several terrain factors including slope, surface configuration, soils, vegetative cover, and surface drainage, all of which are treated in the studies.

Planners concerned with troop stationing also need certain off-post information such as statistics on housing, schools, hospitals, and public utilities in urban areas near installations, as well as pertinent data on airfields and ports in the vicinity. These things are also treated in the studies.

Since the program under which this study was prepared is intended to serve troop stationing requirements, the support provided by the program to environmental requirements is only incidental. While some of the information contained in the studies may be useful as environmental base line data, the studies are by no means complete environmental inventories of the kind required in support of environmental impact assessments.

SCOPE

In scope, the terrain analysis is a compendium of available data on the pertinent natural and manmade features of the reservation and an evaluation of their effects on tactical military operations. The program does not include basic research to fill gaps in these data although some short-term field investigations were performed to obtain ground truth, and general overall appreciation of terrain elements. Therefore, the scope of the analysis is limited primarily to those factors which have been documented by other authorities and to the results of analysis and evaluation of those factors by project technical specialists for topics such as cross-country movement, cover and concealment, and water resources.

The terrain analysis preparation process has necessarily involved analytical judgement in the selection of pertinent source data, resolution of data conflicts, recognition of interrelationships not previously made explicit, and the application of remote sensing to update certain critical, time-variant data such as vegetative cover and manmade features including roads, airfields, and facilities constructed outside the cantonment areas.

LIMITATIONS

The study naturally reflects limitations in the quality, amount, and currency of the source data on which it is based. Numerous field interviews and selective use of remote sensing were employed in an effort to assure presentation of the latest and best information. Within the relatively complex topical scope of the analysis, however, there are a number of aspects on which source data have not been generated with the focus or recency desired to meet objectives fully. As noted under Scope, the study effort was not designed to include basic research as a means of filling gaps in data.

By design, the presentation is cast at a level of data coverage consistent with stated objectives. Users interested in deeper pursuit of data are referred to the List of Sources included as the last page of the study.

PRESENTATION

Maximum use of graphic presentation has been made throughout the terrain analysis. Supporting text is, as far as practicable in tabular format keyed to the related graphics which follow. For most topics, map scales are 1:50,000 and 1:250,000. For Urban Areas (Cantonment Areas), 1:2,400-scale maps are used, and for Off-Post Features the map scale is 1:1,000,000.

STUDY AREA

Fort Irwin is located in south-central California approximately an equal distance between Los Angeles, California and Las Vegas, Nevada. The cantonment area is located at geographical coordinates 35° 15′ N. latitude and 116° 41′ W. longitude. Total acreage of the installation, as originally acquired, is 642,730.7 acres. Barstow Road serves as the only paved access to the post. Barstow is the nearest community and is 56 km (35 mi) southwest of Fort Irwin. Three major highways, Interstates 15, 40, and state highway 58, converge on Barstow.

Fort Irwin is in the Mojave Desert in the Great Basin section of the Basin and Range physiographic province. This region consists of heavily eroded, isolated mountain ranges, which are separated by wide, sloping plains.

Surface water is extremely scarce. Virtually no water exists in streambeds and riverbeds, except following infrequent, heavy rainfalls. The major river in the area is the Mojave river, which runs through Barstow, but does not enter the Fort Irwin reservation at any point.

Vegetation is limited to small desert shrubs and grasses. Joshua trees grow scattered throughout some of the intermontaine plains, and occasionally a few broadleaf trees will grow in valleys and near springs.

The climate is typical of most arid regions. Skies are predominately clear with summers being hot and dry. Temperatures range from the high 90's (°F) to low 100's during the day, and down to the low 70's at night. Winters are moderate with the highest temperatures averaging 57° F, and lowest temperatures averaging 31° F in January. Precipitation is scarce and averages only 64 mm (2.5 inches) per year. Flying weather is good with high ceilings and clear visibilty 350 days of the year.

II. DESCRIPTION AND MILITARY ASPECTS OF TERRAIN

A. SURFACE CONFIGURATION

Fort Irwin is located in the Mojave Desert of southern California which is part of the larger Basin and Range physiographic province. Landforms on the reservation consist of low and high plains covering 66% of the area, low and high hills covering 32% of the area and mountains covering the remainder. The hills and mountain ranges trend roughly northwest-southeast and are rough, barren, dissected and steep. Uplands are usually continuous in the north of the reservation and scattered in the south; several passes cut through these rugged uplands. Between these uplands are the broad, flat to rolling, dissected desert plains, many of which are interconnected. The lower uplands are the broad, flat to rolling, dissected desert plains. In the lowest part of these intermontane basins all drainage is internal toward the playas. Elevations average between 415 and 1280 m (1360 and 4200 ft) above sea level; the lowest elevation, 296 m (970 ft), is the extreme northeast corner of the reservation and the highest elevation, 1866 m (6120 ft), is a crest in the Avawatz Mountains in the northeast.

MAP UNIT	LANDFORM TYPE	LANDFORM DESCRIPTION AND DISTRIBUTION	ELEVATIONS
1	LOW PLAINS	Several broad, low plains in the lower elevations of large depressions separate the generally northwest-southeast trending hill and mountain ranges. About 22% of the reservation is comprised of low plains. The largest continuous area of low plains extends in an arc from northeast to southeast of Bicycle Lake. Surfaces throughout the low plains are predominantly flat to gently rolling, smooth, barren and sandy. Dry washes stretch from bordering uplands toward the lowest part of each plain which generally contains a playa (dry lake bed). Slopes are mainly between 0 and 3%, with local relief generally between 10 and 50 m (33 and 164 ft). Flattest and smoothest surfaces, with virtually no slope or local relief, are the playa floors, dry most of the year (see B, Surface Drainge). The largest playa, Leach Lake in the northern part of the reservation, covers 535 ha (1299.2 acres). The highest local relief, between 40 and 50 m (131 and 164 ft), is mainly on the outward edges of the low, plains. Here they grade into the high plains or low hills; slopes are generally between 3 and 5% and the low, incised banks of dry washes locally exceed 30%.	Most of the surfaces of the low plains lie at 915 to 1096 m (3000 to 3600 ft) above sea level; three large areas are lower, the area surrounding Leach Lake, 579 to 671 m (1900 to 2000 ft), south and east of Bicycle Lake and northwest and east of Langford Well Lake, 488 to 793 m (1600 to 2600 ft), and north of Red Pass Lake, 579 to 610 m (1900 to 2000 ft). The lowest elevation, 415 m (1360 ft), is northwest or Bitter Spring at grid reference NJ506994 and the highest elevation, 1159 m (3800 ft), is northwest of McLean Lake at grid reference NK133293.
2	HIGH PLAINS	High plains cover 44% of the reservation, consisting largely of several narrow to broad expanses, many of which are interconnected. Sloping gradually from the uplands these plains, cut by dry washes, blend into the more gently sloping low plains in the bottom of depressions. Surfaces of the high plains are predominantly gently rolling to rolling with large areas in the west-central and southwest parts strongly rolling and dissected. Generally, the lower slopes are sandy and pebbly; as slopes increase, pebbles grade into cobbles, then into boulders at the upland fronts. Slopes throughout average 3 to 10% with upper slopes increasing to between 10 and 25% where the high plains abut uplands and in the strongly rolling and dissected plains in the west-central and southwestern parts. Local relief ranges from 50 to 150 m (164 to 429 ft),but is predominantly from 100 to 158 m (328 and 429 ft). Dry wash channels, incised in nearly straight channels from the higher slopes of adjacent uplands, are from 1 to 3 m (3 to 10 ft) deep and 1 to 6 m (3 to 20 ft) wide, bank slopes are generally between 30 and 60%, but exceed 60% in some areas. Additional surface irregularities include four small boulder fields in the southwest (NK155068, NK161060, NK172063, NJ235943) and an eolian sand area in the southeastern corner (NJ515987). Boulder diameters in these fields exceed 1 m (3 ft) and sands veneer an area of 1.45 km^2 (0.56 mi^2); depth of sand varies but reaches a maximum of 9 m (30 ft).	Most of the high plains lie between 610 and 1220 m (200 to 4000 ft) above sea level; the high plains in the southern half of the reservation are generally at the low end of this range of elevations. The lowest elevation, 387 m (1270 ft), is in the northeast adjacent to the Avawatz Mountains at grid reference NK590291.
3	LOW HILLS	Low hills, covering 18% of the reservation, are large parts of the roughly northwest-southeast trending Quail, Granite, and Avawatz ranges in the north and the Tiefort, Soda, Alvord, and Paradise Ranges and an area north of Goldstone Lake in the south of the reservation. Several smaller low-hill areas are scattered in the plains, most in the southern half of the reservation. Surfaces are generally rough, barren, moderately to highly dissected with crests moderately sharp. Slopes range from 10 to 30% with large areas 30 to 45% and several upper slopes from 45% to greater than 60%. Local relief, the difference between hilltops and adjacent valley bottoms, ranges from 150 to 300 m (492 to 984 ft).	Most of the low hills range between 985 and 1220 m (3100 and 4000 ft) above sea level with several of the scattered ridges in the south averaging between 610 and 1976 m (2000 and 3200 ft) in elevation. The lowest elevation, 296 m (970 ft), is in the extreme northeast corner of the reservation at grid reference NK457425. The highest hilltop, 1524 m (5000 ft), is at grid reference NK107423 in the foothills of the Quail Mountains in the northwest.
4	HIGH HILLS	Generally east-west trending high hills covering about 14% of the reservation, together with the low hills in Map Unit 3, comprise most of the Quail, Granite, and Avawatz ranges in the north and Tiefort and Paradise ranges in the south, to include the range east of Goldstone Lake. Surfaces are rough, barren and highly dissected with sharp linear crests. Slopes are predominantly between 45 and 60% with large areas over 60%. Local relief, the difference between hilltops and adjacent valley bottoms, generally ranges between 300 and 450 m (984 and 1476 ft); two areas with higher local relief, between 450 and 600 m (1476 and 1968 ft), are parts of the Avawatz Mountains in the northwest and the Tiefort Mountains in the south-central part.	Most of the hills range between 915 and 1280 m (3000 and 4200 ft) above sea level. The lowest elevation, 421 m (1380 ft), is at the foot of a small high hill area in the extreme northwest at grid reference NK458409. The highest elevation, 1762 m (5780 ft) is a hilltop in the Avawatz Mountains in the northwest at grid reference NK289618.
5	MOUNTAINS	Four small mountain areas, comprising about 2% of the reservation, are parts of the east-west trending Granite range in the northwest, the northwest-southeast trending Avawatz range in the northeast and the east-west tréndìng Tiefort range in the south-central part. Surfaces are barren, rough and highly dissected with sharp linear crests. Slopes are largely greater than 60%. Local relief, the distance between crests and adjacent valley bottoms, is between 600 and 700 m (1968 and 2296 ft).	The elevation of these mountains ranges largely between 976 and 1280 m (3200 and 4200 ft) above sea level in the northwest, 1159 and 1707 m (3800 and 5600 ft) in the south-central part. The lowest elevation, 549 m (1800 ft) at grid reference NK432019, is on the southeast corner of the mountains in the south-central part of the reservation. The highest elevation, 1866 m (6120 ft) at grid reference NK602308 is a crest in the Avawatz Mountains in the northeast.

A. SURFACE CONFIGURATION (Continued)

SELECTED PASSES

MAP NO. (NAME)	GRID REFERENCE	MAXIMUM ELEVATION	MINIMUM WIDTH	MAXIMUM SIDE SLOPE	
1	NK134399	1146 m (3760 ft)	5.5 m (18 ft)	E 50%	W 10%
2	NK326303	1017 m (3335 ft)	4.6 m (15 ft)	N 45%	S 70%
3 (Avawatz Pass)	NK515326	1271 m (4169 ft)	4.6 m (15 ft)	E 45%	W 100%
4	NK114184	1007 m (3303 ft)	220 m (722 ft)	E 6%	W 20%
5	NK246262	1067 m (3500 ft)	3.6 m (12 ft)	N 45%	S 45%
6	NK407200	1212 m (3975 ft)	210 m (689 ft)	N 40%	S 10%
7	NK400225	1238 m (4060 ft)	3.6 m (12 ft)	E 45%	W 90%
8	NK278071	829 m (2720 ft)	6.1 m (20 ft)	N 60%	S 90%
9	NK354021	750 m (2460 ft)	100 m (328 ft)	E 45%	W 50%
10	NK488273	1086 m (3563 ft)	6.1 m (20 ft)	N 45%	S 45%
11	NJ189985	1116 m (3660 ft)	15 m (50 ft)	E 6%	W 8%
12	NJ265963	963 m (3160 ft)	6.1 m (20 ft)	N 25%	S 25%
13	NJ243915	896 m (2940 ft)	5.5 m (18 ft)	E 50%	W 90%

B. SURFACE DRAINAGE

All of the surface drainage of Fort Irwin is internal; most of the runoff flows inward from all directions, into ten large depressions containing ephemeral desert lakes (playas). These playas range in area from about, 16 ha (38.4 acres) to about 525 ha (1299.2 acres). The boundaries are approximated, since the slopes of the shorelines are very gradual, rising almost imperceptibly from flat playa bottoms. Drainage is generally in the form of rapid runoff following occasional heavy cloudbursts and may often be classified as flash floods. The infrequent cloudbursts or thunderstorms usually occur during the months of June through September and may supply runoff to the playas in depths of up to 1.2 meters (4 feet); the water,as it evaporates, covers the playas for approximately three to four weeks a year. During these short wet periods, the playa surfaces are very soft, but are hard when dry. Except for brief surges of surface runoff, the drainage features of Fort Irwin remain essentially dry for the remainder of the year.

When an occasionally heavy downpour of rainfall occurs on Fort Irwin, water pours across the bedrock surfaces of the hills and mountains into deeply incised drainage channels and rushes rapidly toward the large depressions below. It emerges from the channels onto widening, nearly flat surfaces in sheet floods. These floods of water then rush out fan-like over surface materials in many spreading channels. These channels may become as deep as 3 meters (10 feet) and as wide as 6 meters (20 feet) in the lower foothills. As the water progresses downward, the fans become wider and less steep, the channels narrower and less incised, and the water in the branching drainage channels slows and is rapidly absorbed by the porous, alluvial surface materials. The much decreased flow then begins merging on the floors of the bowl-shaped basins to settle as ephemeral lakes that become brackish or saline on the silty clay flat bottoms of the depressions. Evaporation prevents these lakes or playas from growing large enough to overflow their basin edges and forming outflowing river systems.

There is a levee built in a rough quarter-circle around the northwest to southwest sides of the cantonment area (grid coordinates NK278030 to NJ278997) to protect it from flash flooding out of the nearby uplands. This structure is approximately 4.1 km (2.5 mi) long, 3 meters (9.8 feet) high, 8 meters (26.0 feet) wide at the base, and is composed of compacted earthfill. Along the length of the middle third of the levee, a layer of tar has been sprayed over the surface to protect it from wind erosion.

EPHEMERAL DESERT LAKES (PLAYAS) AND RESERVOIRS

MAP NO.	NAME	GRID COORDINATE	APPROXIMATE AREA*
1	Leach Lake	NK290378	525 ha (1299.2 acres)
2	McLean Lake	NK214275	116 ha (288 acres)
3	Dixon Lake	NK085192	18.1 ha (44.8 acres)
4	Nelson Lake	NK205205	172 ha (422.4 acres)
5	Kent Lake	NK133163	15.6 ha (38.4 acres)
6	Goldstone Lake	NK095130	499 ha (1235.2 acres)
7	Drinkwater Lake	NK425280	137 ha (339.2 acres)
8	Bicycle Lake	NK340040	378 ha (934.4 acres)
9	Red Pass Lake	NK586025	342 ha (844.8 acres)**
10	Langford Lake	NJ345947	243 ha (601.6 acres)
11	Unnamed reservoir***	NJ310997	2.6 ha (6.4 acres)

*Area of playa obtained by measuring approximate shoreline depicted on 1:50,000 scale topographic maps.

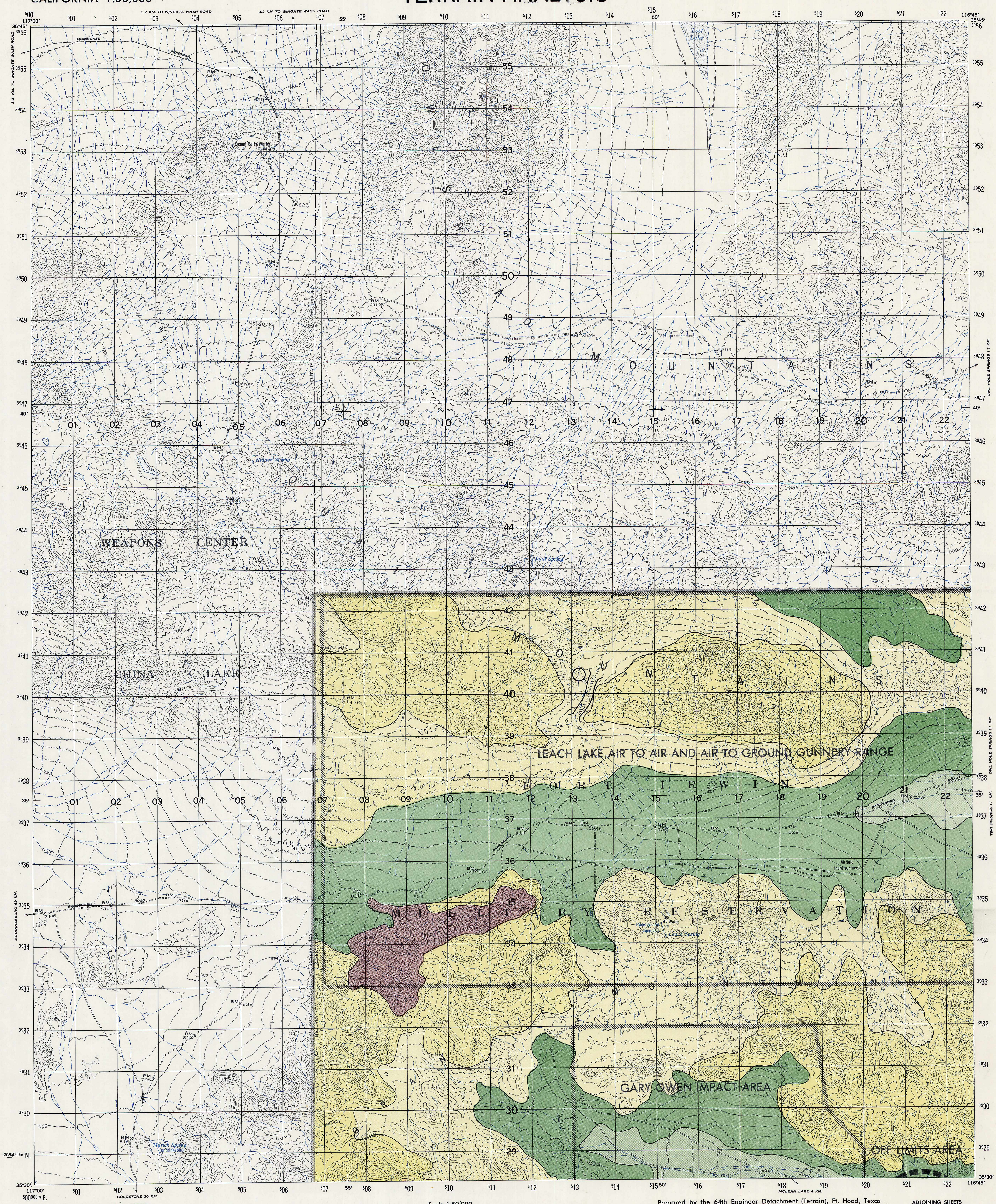
**Includes area outside reservation boundary.

***Reservoir has earth dam.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2655 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2555 I	2655 IV	2655 I
2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I

SURFACE CONFIGURATION/DRAINAGE

1. Low Plains — Predominantly smooth, flat to gentle rolling surfaces, local relief generally 10 to 50 m and slope largely between 0 and 3%.

2. High Plains — Predominantly gently rolling to rolling surfaces with large areas in west-central and southwestern parts strongly rolling and dissected; local relief mostly between 100 and 150 m and slopes largely between 3 and 10%.

3. Low Hills — Predominantly rough, moderate to highly dissected surfaces with tops moderately sharp; local relief generally between 150 and 300 m and slopes mainly between 10 and 30% with upper slopes to 45% or greater.

4. High Hills — Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 300 and 450 m and slopes largely between 45 and 60% or greater.

5. Mountains — Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 600 and 700 m and slopes largely greater than 60%.

Boulder Field

Pass

Playa or Reservoir

Levee

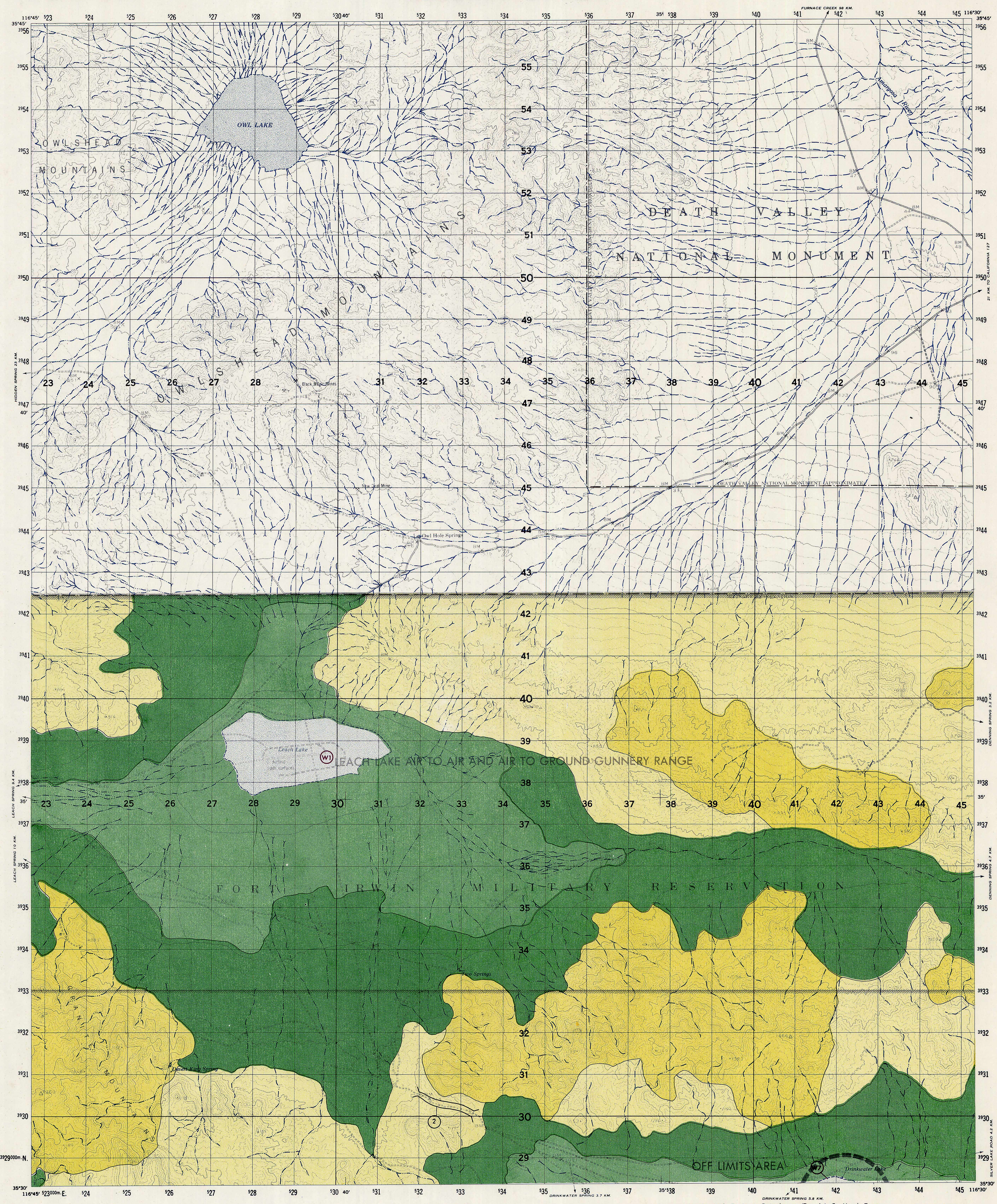
Earth Dam

NOTE: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2655 II



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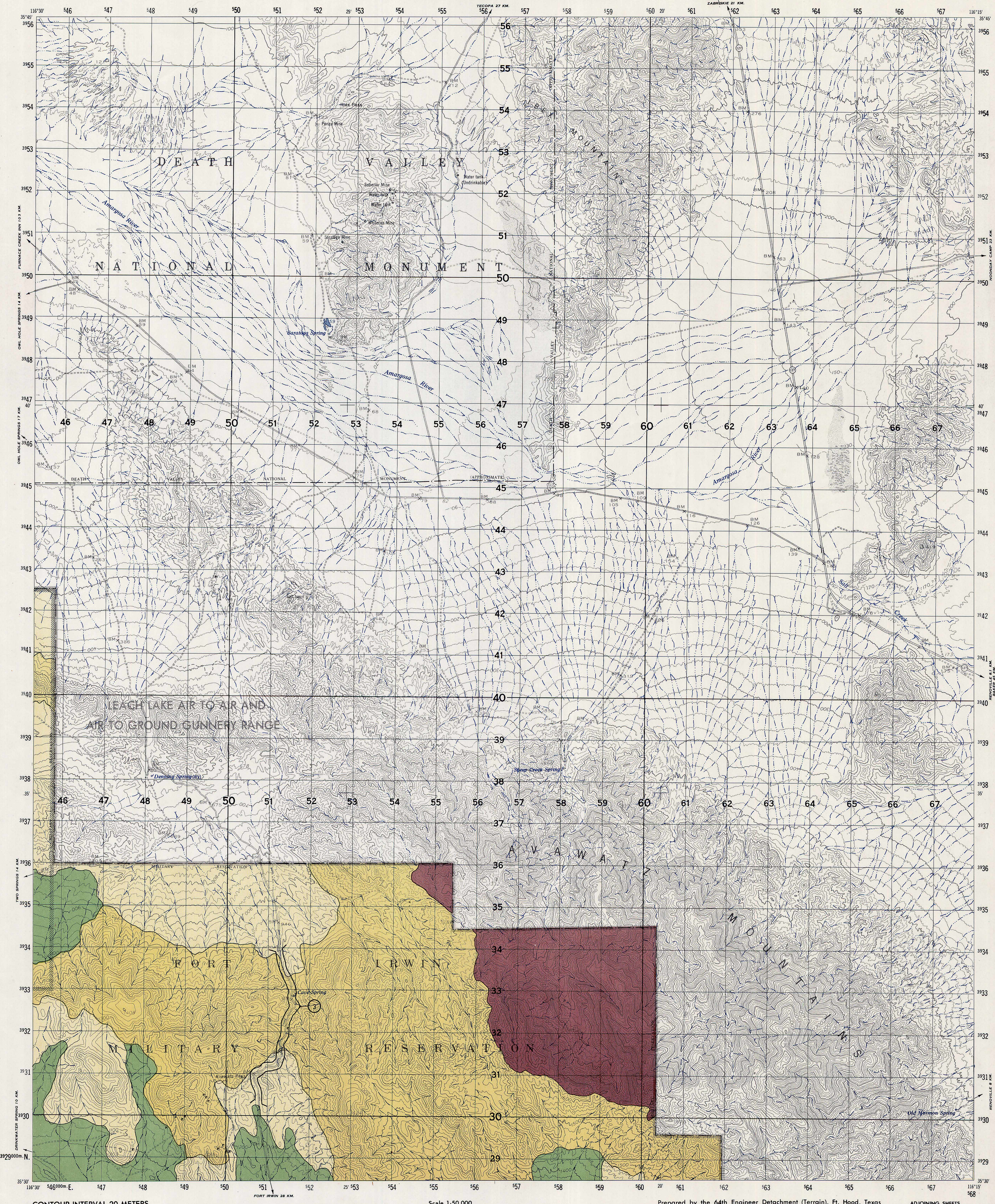

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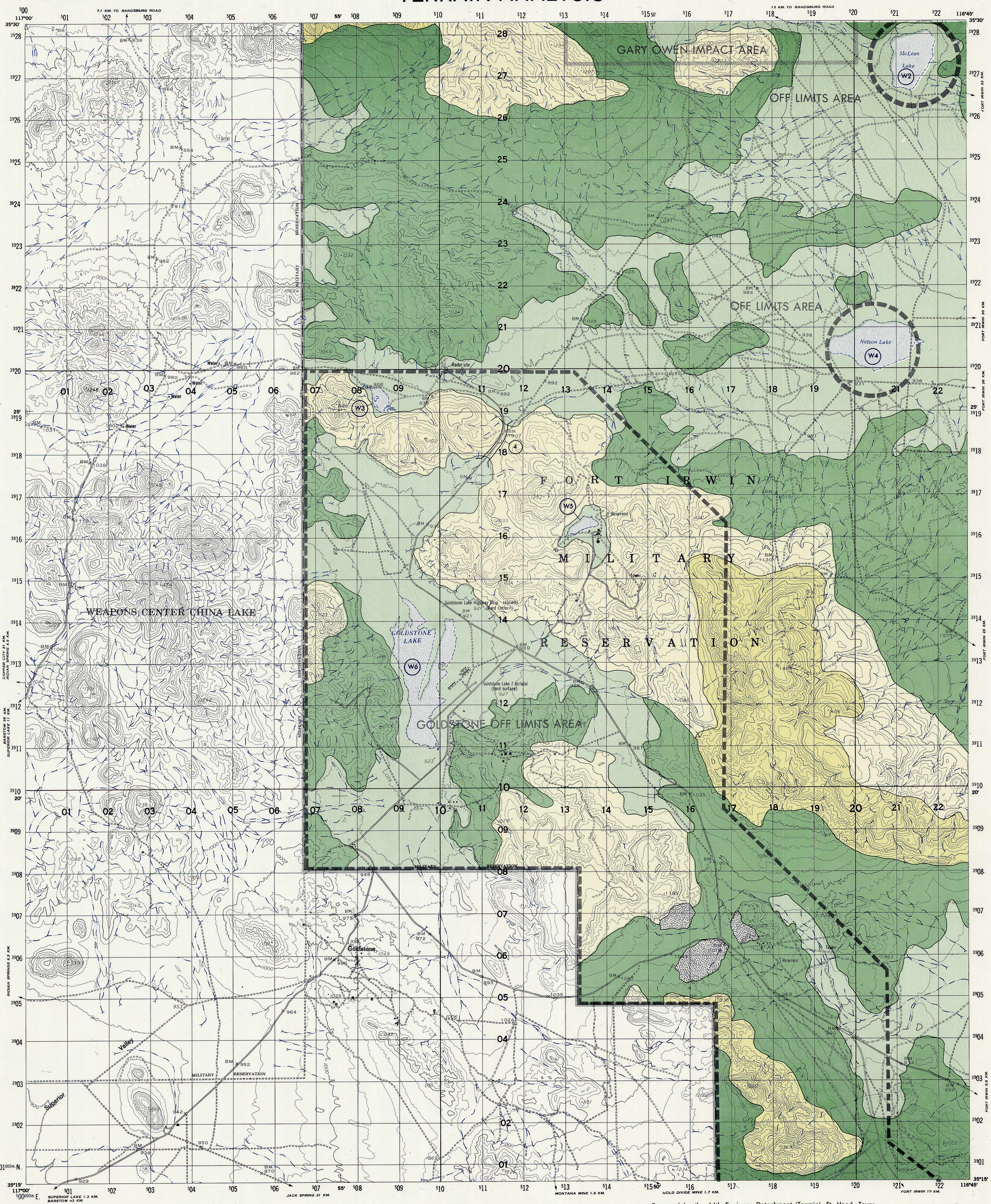
CALIFORNIA 1:50,000

SHEET 2654 IV



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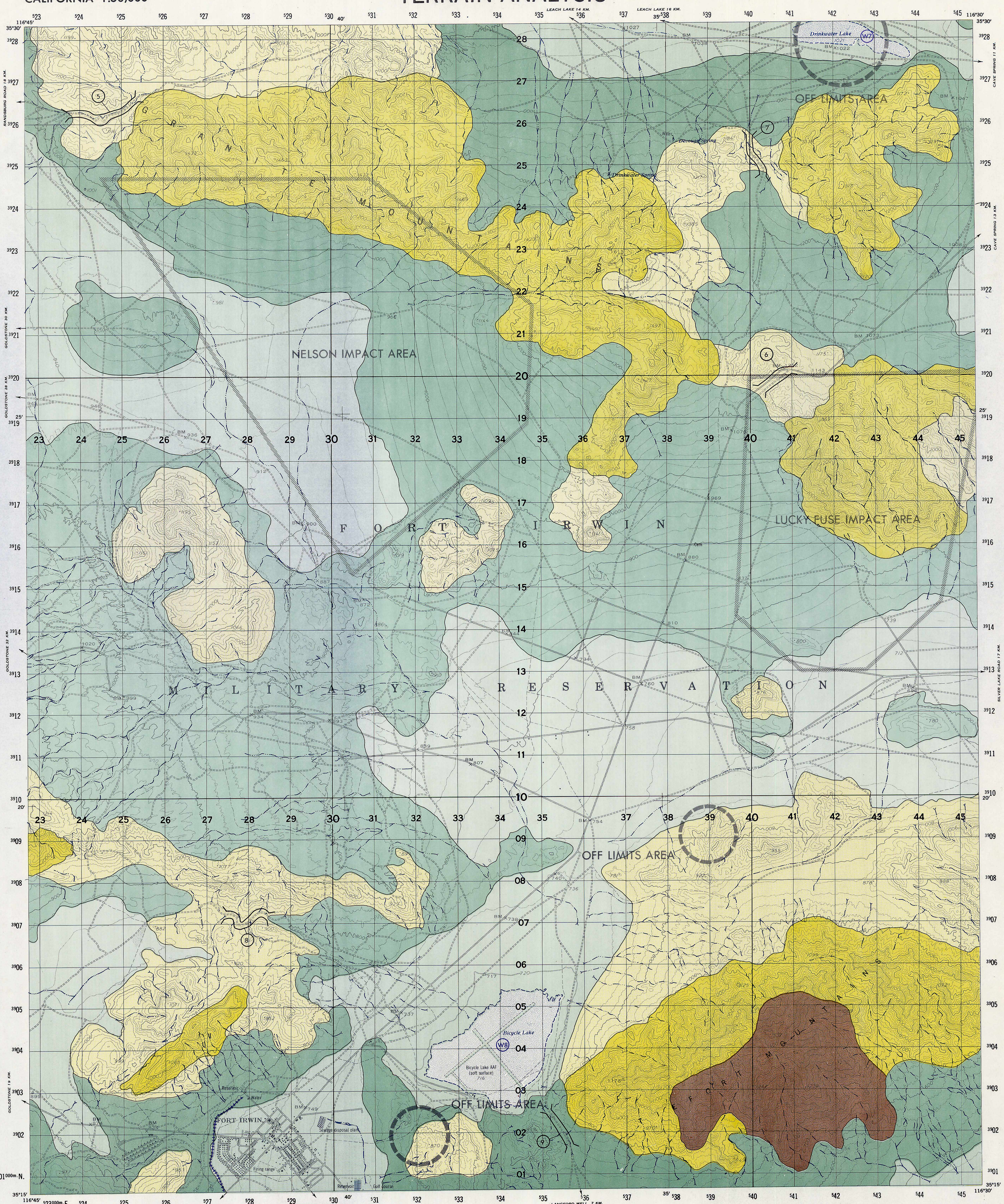


CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III

SURFACE CONFIGURATION/DRAINAGE

1.	Low Plains	Predominantly smooth, flat to gentle rolling surfaces, local relief generally 10 to 50 m and slope largely between 0 and 3%.
2.	High Plains	Predominantly gently rolling to rolling surfaces with large areas in west-central and southwestern parts strongly rolling and dissected; local relief mostly between 100 and 150 m and slopes largely between 3 and 10%.
3.	Low Hills	Predominantly rough, moderate to highly dissected surfaces with tops moderately sharp; local relief generally between 150 and 300 m and slopes mainly between 10 and 30% with upper slopes to 45% or greater.
4.	High Hills	Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 300 and 450 m and slopes largely between 45 and 60% or greater.
5.	Mountains	Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 600 and 700 m and slopes largely greater than 60%.
	Boulder Field	

Pass

Playa or Reservoir

Levee

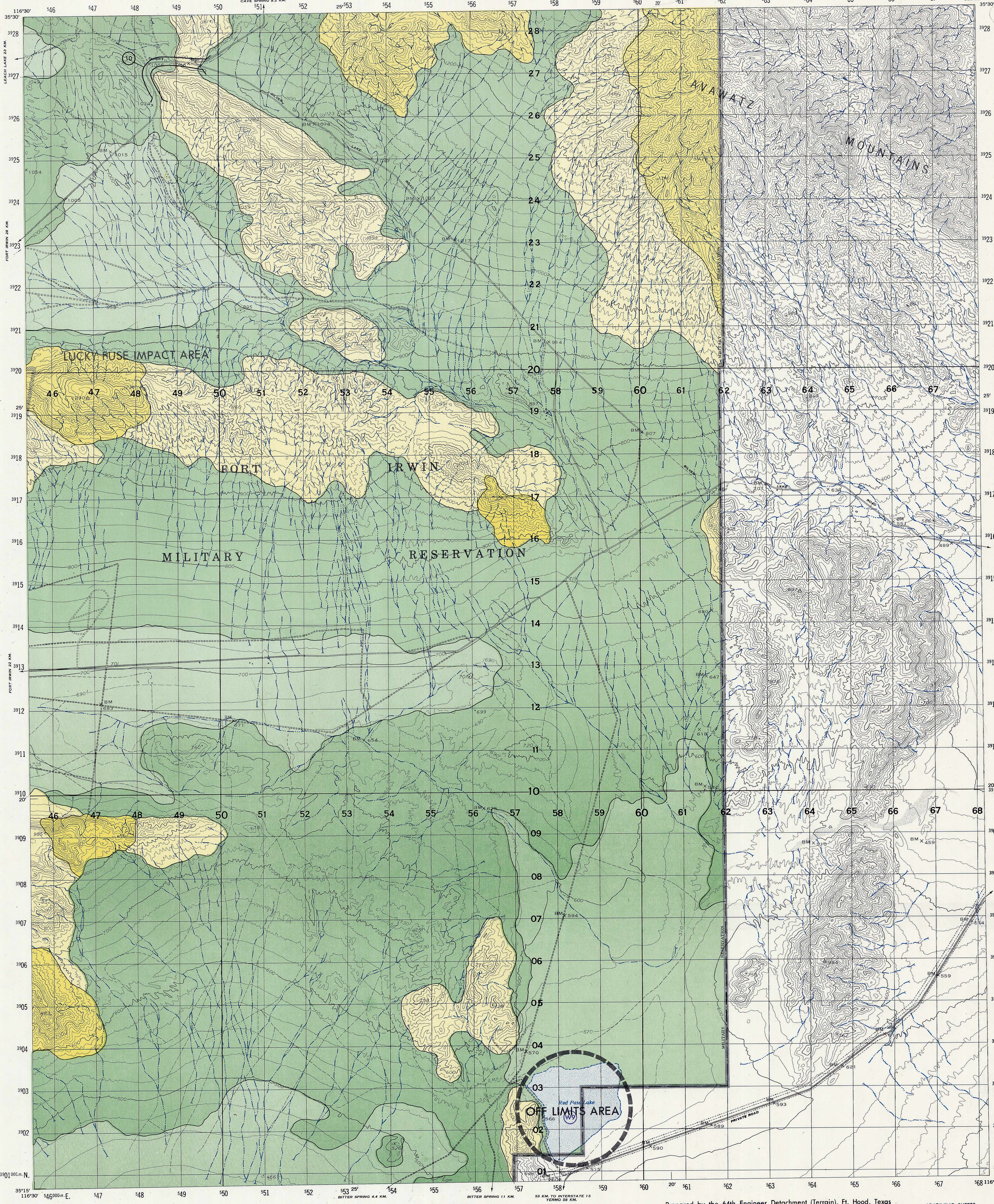
Earth Dam

NOTE: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 IV



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II

SURFACE CONFIGURATION/DRAINAGE

1. Low Plains — Predominantly smooth, flat to gentle rolling surfaces, local relief generally 10 to 50 m and slope largely between 0 and 3%.

2. High Plains — Predominantly gently rolling to rolling surfaces with large areas in west-central and southwestern parts strongly rolling and dissected; local relief mostly between 100 and 150 m and slopes largely between 3 and 10%.

3. Low Hills — Predominantly rough, moderate to highly dissected surfaces with tops moderately sharp; local relief generally between 150 and 300 m and slopes mainly between 10 and 30% with upper slopes to 45% or greater.

4. High Hills — Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 300 and 450 m and slopes largely between 45 and 60% or greater.

NOT ON MAP SHEET — 5. Mountains — Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 600 and 700 m and slopes largely greater than 60%.

Boulder Field

Pass

Playa or Reservoir

Levee

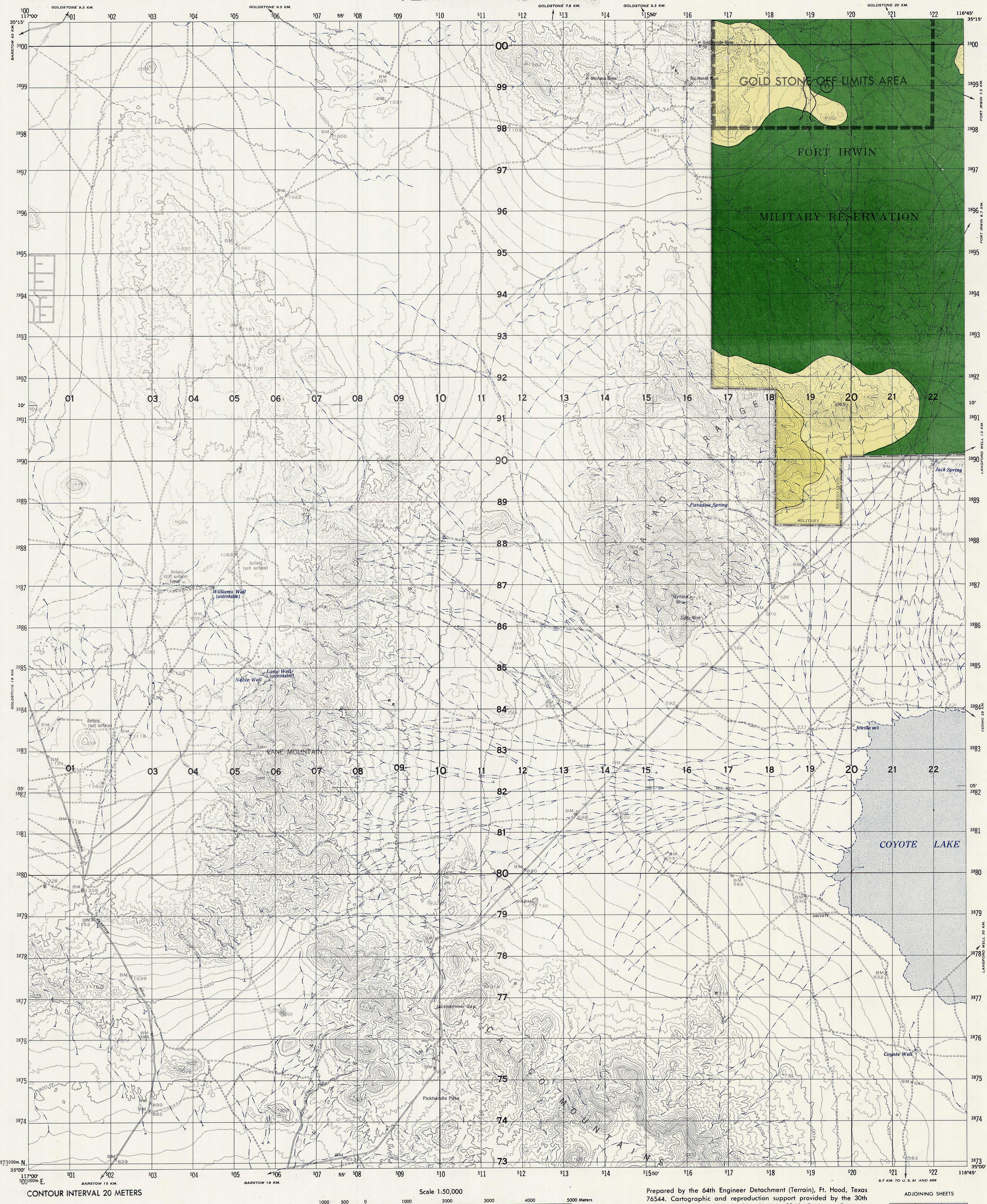
Earth Dam

NOTE: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II
2553 I	2653 IV	2653 I

SURFACE CONFIGURATION/DRAINAGE

1. Low Plains — Predominantly smooth, flat to gentle rolling surfaces, local relief generally 10 to 50 m and slope largely between 0 and 3%.

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NOT ON MAP SHEET

5. Mountains — Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 600 and 700 m and slopes largely greater than 60%.

Boulder Field

Pass

Playa or Reservoir

Levee

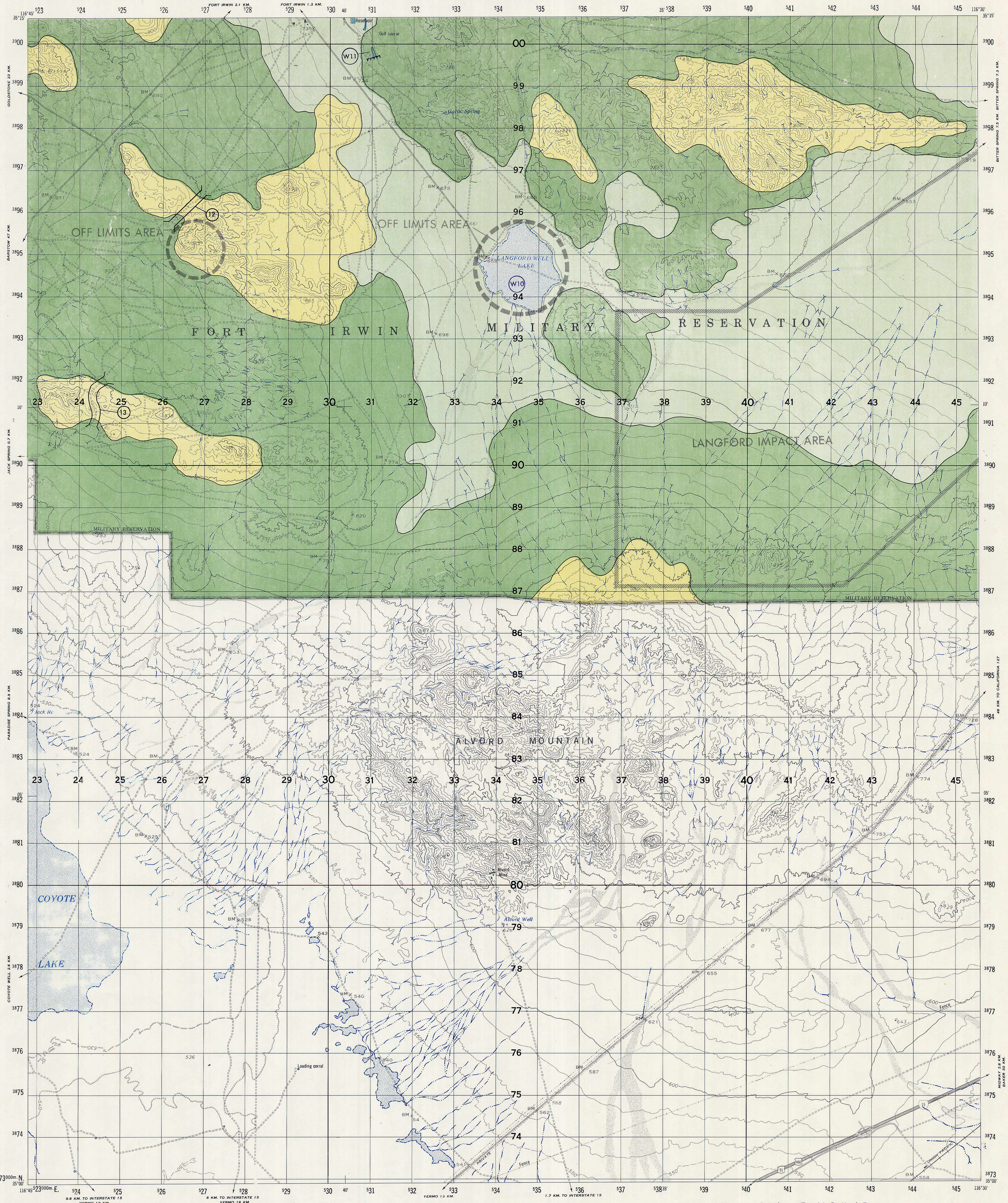
Earth Dam

NOTE: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 II



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III
2653 IV	2653 I	2753 IV

SURFACE CONFIGURATION/DRAINAGE

1. Low Plains	Predominantly smooth, flat to gentle rolling surfaces, local relief generally 10 to 50 m and slope largely between 0 and 3%.
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NOT ON MAP SHEET — 5. Mountains	Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 600 and 700 m and slopes largely greater than 60%.
Boulder Field	

Pass

Playa or Reservoir

Levee

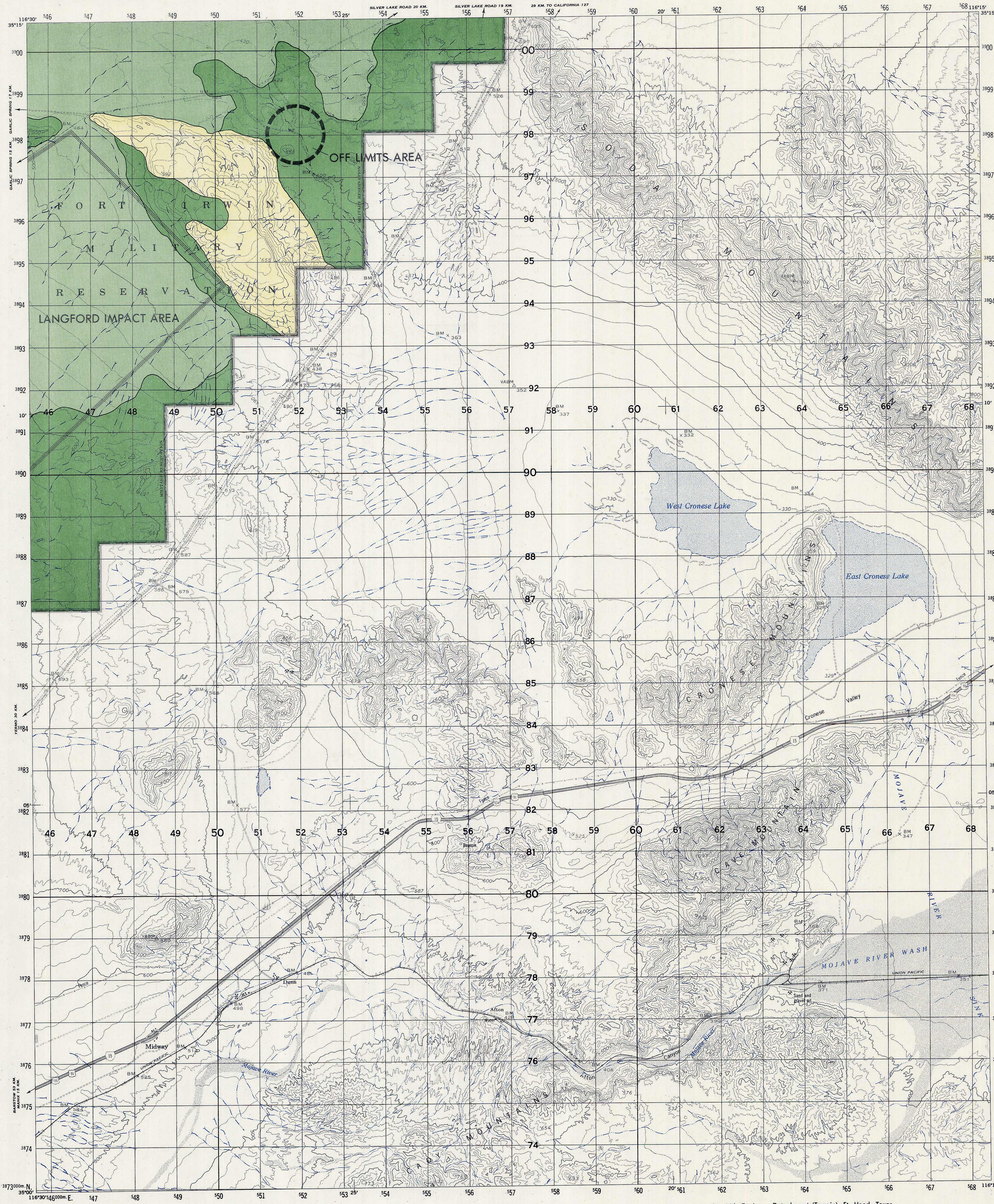
Earth Dam

NOTE: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II
2653 I	2753 IV	2753 I

SURFACE CONFIGURATION/DRAINAGE

1. Low Plains — Predominantly smooth, flat to gentle rolling surfaces, local relief generally 10 to 50 m and slope largely between 0 and 3%.

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NOT ON MAP SHEET

5. Mountains — Predominantly rough, highly dissected surfaces and sharp linear crests; local relief generally between 600 and 700 m and slopes largely greater than 60%.

Boulder Field

Pass

Playa or Reservoir

Levee

Earth Dam

NOTE: Number refers to entry in table.

C. WATER RESOURCES

1. SURFACE WATER

Surface water is scarce in the Fort Irwin area. All streams are intermittent, flowing only during periods of heavy rains or thunderstorms which occur during the months of June through September. On Fort Irwin, 10 playas collect runoff from heavy storms. Playas range in size from 137 hectares (339.2 acres) to 525 hectares (1297.2 acres), with an average maximum depth of 1 meter (3.3 feet). Standing water is a result of low infiltration rates in the evaporated clay lake beds and is a short-lived phenomenon.

There are also 8 springs within the reservation. These produce little water during the summer months; the quantity varies with the amount of available ground water. See tables below for additional information.

SPRINGS

NAME	GRID COORDINATE
Leach Spring	NK152342
Desert King Spring	NK260312
Two Spring	NK330335
Cave Spring	NK516329
Drinkwater Spring	NK366247
Devouge Spring	NK382256
Garlic Spring	NK327984
Bitter Spring	NK518982

There are few available data concerning the quality of the water produced by the above springs. However it is believed that they would produce meager to small quantities of slightly brackish water.

2. GROUND WATER

Significant quantities of ground water at Fort Irwin are available only from several basinal lowlands which are enclosed by rugged east- and southeast-trending bedrock uplands. Most of the water occurs in the thick gravelly sands and silts of the broad, gently sloping plains; less occurs in gravels fringing the uplands, and little or none in the clayey materials prominent at the lowest places in the basins. Only meager quantities may be tapped by wells intersecting joints, fractures, or faults in the bedrock uplands.

The Langford Lake, which includes the Fort Irwin cantonment area, and Bicycle Lake ground water basins supply the water used at Fort Irwin cantonment area. Recharge to these basins, as to all others in this desert environment, is limited, and production should be carefully managed to assure adequate reserves and to prevent ground subsidence caused by excessive-withdrawl.

All surface drainage on the reservation is ephemeral, carrying runoff only during, and for a short time after, rains. All drainage is also internal, never exiting from the basin in which it originates. Runoff that is not absorbed or evaporated in flowing across the broad plains collects as temporary shallow lakes (playas) in some basins. Evaporation of the lake waters results in precipitation of alkali salts at or near the surface.

Several small springs on the reservation have supplied meager to small quantities of brackish water to travellers for many years. During periods of unusually low water table, these springs may go dry.

Water from most wells and springs at Fort Irwin is considered to be unacceptable for domestic or irrigation use. Analyses show an average of greater than 400 milligrams per liter dissolved solids from well waters, with bicarbonate, sulfate, chloride, and sodium as predominant ions. pH ranges from 7.1 to 8.5; average temperature is 25°C. Defluoridation and other treatment is necessary to bring the water up to an acceptable standard.

MAP UNIT	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
1	Two areas on Fort Irwin can supply moderate* to large quantities of ground water, to a maximum of 3.975 lpm (4500 gpd). The Langford Well Lake basin, in which the cantonment area is located, supplies water from numerous wells; specific capacities range from 41 lpm/m (3.3 gpm/ft) to 343 lpm/m (27.6 gpm/ft). The six wells in the cantonment area yield 378 lpm (144,000 gpd) to 2650 lpm (1,000,000 gpd). Bicycle Lake basin supplies the remainder of the water used on Fort Irwin. Specific capacities range from 194 lpm/m (15.6 gpm/ft) to 311 lpm/m (25 gpm/ft), based on 12-hour pumping tests. Unconsolidated alluvium is the source of the ground water on the reservation in this unit. Coarse gravel and sand of the alluvial fans near uplands grade into and are intermixed with fine sand and clay layers and lenses in the lowlands. Silt and clay in the lowest areas, commonly residual from playa deposits, may form impermeable zones which partially seal the alluvium, causing an increase in water pressure below the zones and leading to near-artesian conditions when the zones are penetrated.	Wells in the Langford Well Lake basin, including the cantonment area, range in depth from 130 m (430 ft) to 229 m (750 ft), with five producing zones 52 m (170 ft) to 110 m (360 ft) below the surface. In the Bicycle Lake basin the wells are 152 m (500 ft) to 180 m (614 ft) deep, with three producing zones approximately 100 m (328 ft) below the surface, each of which is 1.5 m (5 ft) to 46 m (150 ft) thick.	Ground water on Fort Irwin is of marginal to inferior quality and is unsuited for domestic or irrigational use. It generally is high in fluoride, iron, and sodium with excessive bicarbonate and sulfate ions. Water from different wells is blended to reduce overall concentration of impurities and defluoridation unit has been installed to reduce fluoride concentrations. Treated water for drinking and cooking is distributed to the housing areas by a separate system of 5 cm (2 in) galvanized iron pipes; the manufacturers' rated capacity for this unit is 38,000 gpd. Water at Langford Well Lake basin has a fluoride concentration of 10 ppm, and total dissolved solids of 472 mgl to 634 mgl. Bicycle Lake basin water has a fluoride concentration of 1.6 mg/l and total dissolved solids of 608 mg/l. Water from cantonment wells has a fluoride concentration of 6 to 8 ppm, total dissolved solids are 550 mg/l and the pH averages 7.6.	Access to potential well-drilling sites is unrestricted. The flat desert plains provide a stable surface for drilling platforms. All wells were drilled by the cable-tool method. Most wells are cased throughout their lengths, with casing diameters from 36 cm (14 in) to 64 cm (24 in); all casings are perforated from the static water level to the bottom of the well to permit maximum recovery of water.
	Several basins on the reservation can supply small to moderate quantities of water. Two tests wells have been drilled in the Red Pass Lake and Cronese Lakes basins. Yields vary from 95 lpm (25 gpm) to 228 lpm (60 gpm) with zones of production from 8 m (26 ft) to 21 m (70 ft) in thickness. Water is derived from aquifers composed of gravels and clays. Inflow to the basins is from surrounding highlands. The Cronese Lakes basin also receives limited and erratic inflow from the Mojave River. Nelson Lake basin is also internally drained, with a playa located centrally in the basin. Ground water supplies are derived only from runoff. The northern portion of Leach Lake ground water basin has an unusually high water table for this region with several springs with small flows of brackish water.	Test wells in the Red Pass Lake, Cronese Lakes and Goldstone Lake ground water basins are between 131 m (430 ft) and 152 m (500 ft) deep, and have static water levels ranging from 48 m (157 ft) below the surface in the Goldstone area to 112 m (368 ft) below in the Red Pass area. Well logs are not available for Nelson Lake and Drinkwater basins. Leach Lake ground water basin, which is divided by a fault, falls in this unit, as the northern portion of the basin has a high water table and several free-flowing springs. The water table in this area is commonly within 3 m (10 ft) of the surface, but because of high evaporation rates, there is seldom standing water in the region.	Ground water in basins producing small to moderate quantities is of inferior quality for both irrigational and domestic use. The water recovered from the Cronese Lakes basin has a fluoride content of 3.4 mg/l and a boron content of 2.5 mg/l with dissolved solids content ranging from 500 to 3000 mg/l, averaging 1680 mg/l. Analysis of the water from wells in the Goldstone Lake basin shows a fluoride concentration of 1.0 mg/l, boron 0.5 mg/l total dissolved solids at 1200 to 3500 mg/l, a pH of 7.5 to 8.4 and excessive concentrations of calcium, sodium, chloride, and sulfate ions. Analyses from other basins are not available.	Access to well drilling sites is unrestricted. The gently sloping plain provides a stable surface for drilling platforms. Wells in this unit were drilled by the cable-tool method and have casings ranging from 36 cm (14 in) to 64 cm (24 in) in diameter. Carefully drilled and developed wells in the Cronese Lakes and Red Pass Lake basins can provide limited supplies of water for the cantonment area or for other activities.

C. WATER RESOURCES (Continued)

2. GROUND WATER (Continued)

MAP UNIT	QUANTITY AND SOURCE	DEPTH	QUALITY	DEVELOPMENT OF SOURCES
3	Playas, yielding small quantities of poor quality water are the most common expression of this unit. With the exception of Leach Lake, all the playas are dry throughout most of the year. For several weeks each year, usually following heavy rains, several feet of water will stand on the playa surfaces. These playas result from a combination of internal drainage, high concentrations of salts, silt, and clays derived from local rock, and high evaporation rates. Because of the high concentration of fine materials, these deposits are incapable of yielding large quantities of water. Ground water levels beneath most playas in this region exceed 30 m (100 ft). The unconformity caused by a fault bisecting Leach Lake brings the water table up to within 3 m (10 ft) of the surface of the northern sector of the playa.	The depth to water beneath most playas is in excess of 30 m (100 ft). The moist northern sector of Leach Lake usually has a static water level within 3 m (10 ft) of the surface.	Chemical analysis of water from this unit shows the water to be inferior for irrigational or domestic use. Fluoride content ranges from 2 to 22.5 mg/L; bicarbonate, sulfate, and sodium ion concentrations are also excessive. Total dissolved solids are from 308 to 700 mg/L.	Except during flash flooding or following heavy rain, access to drilling sites is unrestricted. Dry playas are covered with a crust of clay, silt, and salts which makes a stable platform. When wet, however, this platform loses all strength and will not support drilling operations. Production costs should be carefully weighed against the quality and quantity of water available from this unit prior to drilling.
	There are no wells in unit four. This unit, consisting of granitic mountains and highlands and basalt and metasedimentary uplands, will at best produce meager to small quantities of water. Wells, sited at intersections of faults, joints, or fractures might provide small to meager quantities of brackish water.	Detailed data on the depth of wells in the highlands are not available. The depth to ground water, possibly confined by joints, fractures, or faults, could be within 30 m (100 ft) of the surface.	The only data that can be used to estimate the quality of the ground water are those local spring water quality. Generally, spring water is marginal for domestic use because of high fluoride and sodium content.	Rugged highlands make drilling operations difficult. The cost of recovering the water versus the quantity and quality of water should be considered prior to the development of this source.

*Definitions of underlined terms are as follows:

Quantity	Liters per minute	Gallons per minute
Large	400 - 4000	100 - 1000
Moderate	40 - 400	10 - 100
Small	4 - 40	1 - 10
Meager	4	1

Brackish - dissolved solids = 1500 mg/L to 15,000 mg/L

Mg/L - for the purposes of this study, milligrams per liter are equivalent to parts per million.

WATER USAGE RATINGS

CONSTITUENT*	SUITABLE	MARGINAL	INFERIOR
		DOMESTIC**	
Total Dissolved Solids	0 - 1000	1000 - 2000	2001+
Nitrate	0 - 45	45 - 88	89+
Fluoride	0 - 0.7	0.7 - 1.5	1.5+
Sulfate	0 - 250	251 - 500	501+
		IRRIGATION**	
Conductivity (EC x 10^6 @ 25° C)	0 - 1500	1500 - 3000	3001+
Boron (B)	0 - 1	1 - 2	2+
Chloride (C)	0 - 350	351 - 500	501+
Per Cent Sodium	0 - 60	61 - 75	76+

CONSTITUENT*	MAXIMUM ACCEPTABLE CONCENTRATION
	MILITARY***
Copper	1.0
Iron	0.3
Manganese	0.05
Zinc	5.0
Magnesium	125.0
Chlorides	250.0
Sulfates	250.0
Phenolic compounds	0.001
Lead	0.05
Hexavalent Chromium	0.05
Fluoride	1.5
Turbidity (silica scale)	5.0
Color (platinum-cobalt scale)	15.0
Nitrate-Nitrogen	10.0
Total solids	500.0

* All values are in mg/L unless otherwise specified.

** From California Department of Water Resources bulletin No.106 -1, June 1964, p. 83.

*** From US Army TM 5-700, para 19.

C. WATER RESOURCES (Continued)

2. GROUND WATER (Continued)

CHEMICAL ANALYSIS OF WELL WATER *
IN MILLIGRAMS PER LITER **

MAP NUMBER	WELL NUMBER	DATE SAMPLED	SILICA (SiO^2)	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	BICARBONATE (HCO_3)	CARBONATE (CO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	DISSOLVED SOLIDS	HARDNESS	pH
1	Fort Irwin No. 1	10-11-60	63	0.60	38.0	16	170	12	118	0	226	139	5.0	20	776	160	7.8
2	Fort Irwin No. 2	10-11-60	73	0.04	14.0	4.9	121	9.6	116	0	134	60	6.0	9.2	510	55	7.9
3	Fort Irwin No. 3	10-5-53	65	0.07	16.0	3.5	112	9.6	128	0	109	54	6.0	11	462	54	7.8
4	Fort Irwin No. 4	10-5-53	64	0.0	11.0	2.5	144	9.2	112	0	141	62	10	5.4	509	38	7.8
5	Fort Irwin No. 5	9-9-55	28	5.5	18.0	2.2	149	10.9	—	—	127	72	7.4	3.8	517	44	7.6
6	Fort Irwin No. 6	10-16-61	74	0.01	6.0	3.9	133	7.6	123	0	131	52	11	5.8	400	36	8.1
7	Fort Irwin No. 7	—	29.4	0.09	22.9	3.5	10	1.05	—	—	155	80	9.0	—	592	68	7.3
8	Fort Irwin No. 8	—	34.4	1.18	32.8	10.2	7.5	0.8	—	—	140	78	5.4	—	592	60	7.6
11	B-1	—	33	0.01	44.0	10.7	138	13.7	—	—	87	94	1.9	3.8	576	120	7.4
12	B-2	—	40	0.1	28.0	4.7	149	32	—	—	123	62	2.2	5.8	608	76	7.6
13	B-4	—	40	0.06	26	4.4	144	32	—	—	123	65	2.0	5.3	584	76	7.6
18	Goldstone Well A	1943	—	0.15	—	—	227	—	—	—	—	211	631	1.0	1818	681	—
19	Goldstone Well 1	1958	65.6	Trace	156.6	26.8	216.4	—	—	105	0	186.4	490	0.1	1247	501.6	7.5
20	Goldstone Well 2	7-5-61	—	0.75	330	44	252	31	54	0	324	825	0.4	0.9	2223	960	7.7
21	Goldstone Well 3	1-16-62	—	2.0	115	38	134	22	48	0	106	412	0.8	2.15	1262	443	7.9

* All analyses completed by the U.S. Geological Survey and the U.S. Department of Health.
** For practical purposes, milligrams per liter and parts per million may be considered equivalent.
— No data recorded.

Note - There is no data for map numbers 9, 10, 14, 15, 16, 17, 22, 23.

2. GROUND WATER (Continued)

SELECTED WELL DATA

MAP NUMBER	WELL NUMBER	WELL DIAMETER cm in	WELL DEPTH m ft	CASING DEPTH m ft	YIELD lpm gpm	WATER LEVEL DEPTH BELOW SURFACE m ft	LAND SURFACE ELEVATION m ft	TEMPERATURE °C °F	DATE COMPLETED	DATE MEASURED	REMARKS
1	Fort Irwin 1	61 24	160 524	160 524	997 258	-70 -229	698.73 2291.83		Mar 1941	Feb 1955	Used for family housing area.
2	Fort Irwin 2	61 24	159 521	159 521	1249 330	-66 -215	698.75 2291.90		Mar 1941	Feb 1955	Used for family housing area.
3	Fort Irwin 3	36 14	152 500	152 500	659 174	-62 -205	698.70 2291.75		Nov 1942	Feb 1955	
4	Fort Irwin 4	36 14	131 430	131 430	556 147	-55 -181	698.57 2291.75		Dec 1942	Feb 1955	
5	Fort Irwin 5	36 14	168 551		931 246	-54 -176	698.86 2292.27		Jul 1943	Feb 1955	
6	Fort Irwin 6	36 14	168 550		1522 402	-54 -176	698.86 2292.27		1943	Feb 1955	
7	Fort Irwin 7				3895 1029						
8	Fort Irwin 8		229 750		727 192						
9*	Fort Irwin 9										
10*	Fort Irwin 10										
11	B-1		183 600	122 400	2377 628	-53 -174	729.6 2393.3	27 80	Jun 1965	Jun 1965	
12	B-2		183 600	108 355	202 534	-62 -202	736.92 2417.70	23 73	Nov 1964	Nov 1974	
13	B-4	36 14	187 614	112 368	3778 998	-62 -203	736.03 2414.80	27 80	Jun 1965	Jun 1975	
14	Langford Lake Well 1	36 14	152 500	152 500	2631 695	-29 -95	669.4 2196.3	23 74	Dec 1954	Dec 1954	
15	Bitter Springs L-4	36 14	131 430	131 430		-56 -184	502.9 1650.0		Jan 1944	Jan 1944	Test well.
16	B-3	36 14	152 500	146 478		-58 -190	735.4 2412.6	34 94	Jan 1965	Jan 1965	Dry hole, not used
17	Red Pass L-1		152 500			-112 -368			May 1944	May 1944	Test well.
18	Goldstone Well A	20 8	101 330		114 30	-69 -228			Pre 1943		
19	Goldstone Well 1	25 10	129 423		114 30	-67 -220			Pre 1956		
20	Goldstone Well 2	30 12	101 330		227 60	-48 -157			1958		
21	Goldstone Well 3				231 61	-42 -138			1961		
22	Goldstone Well 4				227 60	-53 -175					
23	Goldstone Well 5					-46 -150					

*Not shown on map.

C. WATER RESOURCES (Continued)

2. GROUND WATER (Continued)

LOGS OF SELECTED WELLS

Five well logs from Fort Irwin were chosen as being representative from among thirteen available. They are identified in the table below by the corresponding number shown on the accompanying maps. The descriptions of the logs are as documented by the U.S. Army Corps of Engineers, Los Angeles District, and in the U.S. Geological Survey Water - Supply Paper 1460-F, except for metric equivalents which have been added.

FORT IRWIN WELL 1
(Map Number 1)

Location: Cantonment area, bldg. no 5
Driller: E.W. Brockman
Drilled: Mar 1941

San Bernardino County
Elevation: 699 m/2292 ft

	THICKNESS (m)	THICKNESS (ft)	DEPTH (m)	DEPTH (ft)
Sand	0.9	3	0.9	3
Clay, hard, decomposed, granitic, and conglomerate	17.4	57	18.3	60
Granite, soft, decomposed	6.1	20	24.4	80
Granite, hard, decomposed	45.7	150	70.1	230
Sand and small gravel	1.8	6	71.9	236
Granite, hard, decomposed, and clay	2.7	9	74.7	245
Gravel	6.4	21	81.1	266
Clay	1.2	4	82.3	270
Gravel	3.7	12	86.0	282
Clay	0.9.	3	86.9	285
Gravel, dirty, and considerable clay	44.5	146	131.4	431
Clay, hard, sandy	1.8	6	133.2	437
Clay, silt, and gravel	19.2	63	152.4	500
Clay, hard	7.3	24	159.7	524

FORT IRWIN WELL 5
(Map Number 5)

Location: Cantonment area, bldg. no. 319
Driller: Roscoe Moss Co.
Drilled: Jul 1943

San Bernardino County
Elevation: 699 m/2292 ft

	THICKNESS (m)	THICKNESS (ft)	DEPTH (m)	DEPTH (ft)
Sand and gravel	0.9	3	0.9	3
Sand and gravel, cemented	5.8	19	6.7	22
Sand and gravel with some clay	14.0	46	20.7	68
Clay, sandy	22.6	74	43.3	142
Sand and gravel, cemented	4.3	14	47.5	156
Sand and gravel, small	7.9	26	55.5	182
Sand and gravel, streaks of clay (first water at 208 ft)	9.1	30	64.6	212
Sand and gravel	7.3	24	71.9	236
Sand and clay	2.4	8	74.4	244
Gravel with some clay	11.3	37	85.6	281
Rock and gravel	9.4	31	95.1	312
Gravel and clay	2.1	7	97.2	319
Clay and lava boulders	9.4	31	106.7	350

TEST WELL L-1, near Red Pass
(Map Number 17)

Location: 28.6 km (17.8 mi) E of cantonment area
Driller: Roscoe Moss Co.
Drilled: May 1944

San Bernardino County
Elevation: Unknown

	THICKNESS (m)	THICKNESS (ft)	DEPTH (m)	DEPTH (ft)
Sand, clay, some gravel	61.0	200	61.0	200
Sandy clay	50.3	165	111.3	365
Brown clay	6.1	20	117.3	385
Very fine silty running sand	4.6	15	121.9	400
Red clay, some sand and gravel	15.2	50	137.2	450
Yellow clay, some sand and gravel	15.2	50	152.4	500

EXPLORATION WELL B-2
(Map Number 12)

Location: 7.25 km (4 mi) N of cantonment area on Barstow Road (KN342071)
Driller: Roscoe Moss Co.
Drilled: Nov 1964

San Bernardino County
Elevation: 737 m/2418 ft

	THICKNESS (m)	THICKNESS (ft)	DEPTH (m)	DEPTH (ft)
Gravelly sand with cobbles	6.7	22	6.7	22
Gravelly silty sand, few clay streaks, some cementation	93.9	308	100.6	330
Sandy silt, very tight	3.0	10	103.6	340
Gravelly sand	6.1	20	109.7	360
Sandy silt, very tight	3.0	10	112.8	370
Gravelly silty sand, moderately compacted, small amount of clay; tight	36.0	118	140.8	462
Sandy silt, fine, very tight	2.4	8	143.3	470
Gravelly sand	6.1	20	149.4	490
Sand and sandy silt; very fine, cemented	4.6	15	153.9	505
Gravelly silty sand	19.8	65	173.7	570
Silty sand, tight	3.0	10	176.8	580
Gravelly sand	6.1	20	182.9	600

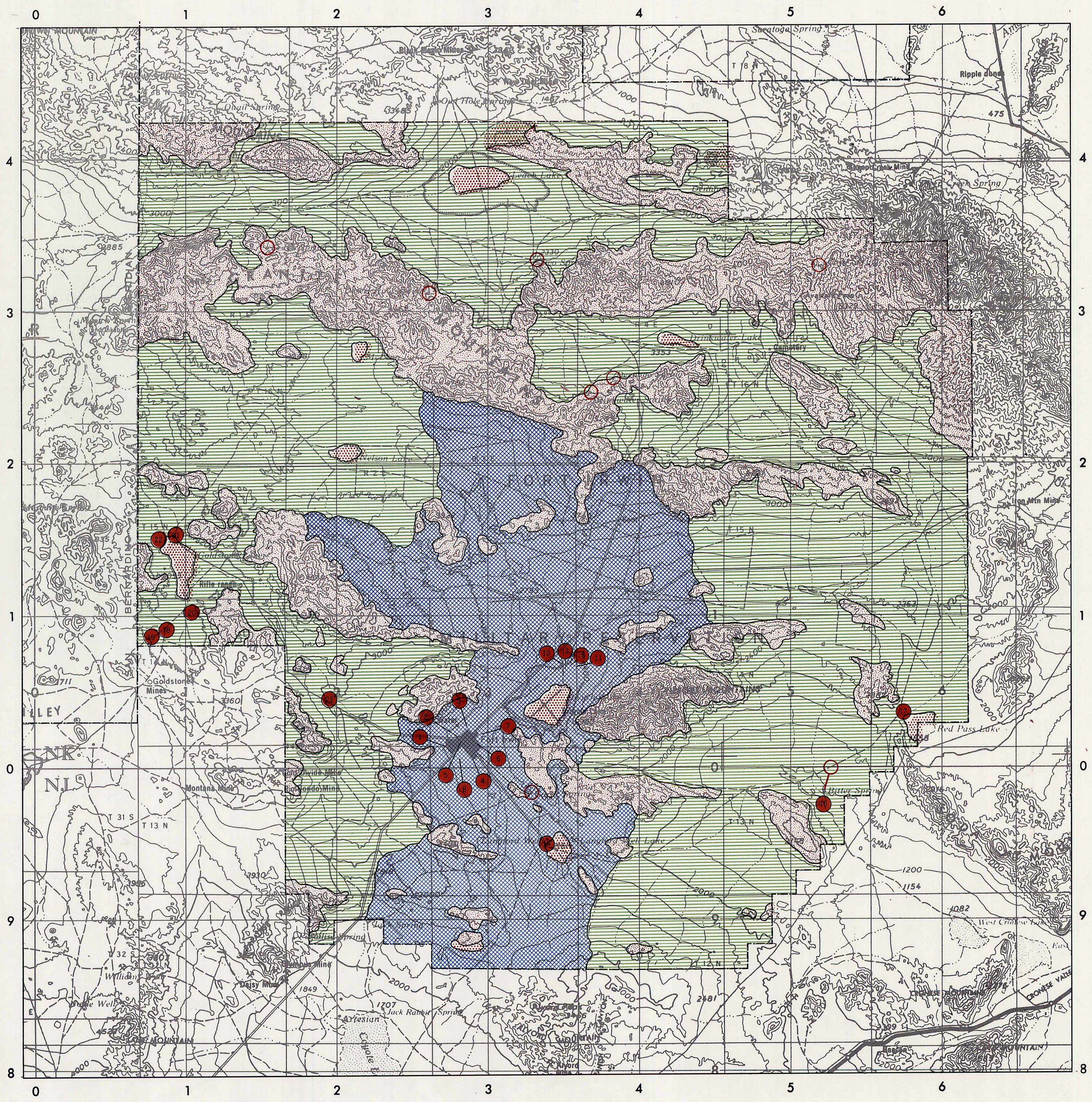
LANGFORD LAKE WELL 1
(Map Number 14)

Location: 7.7 km (4.8 mi) SE of cantonment area on Langford Lake Rd (NK337952)
Driller: Roscoe Moss Co.
Drilled: Dec 1954

San Bernardino County
Elevation: 670 m/2196 ft

	THICKNESS (m)	THICKNESS (ft)	DEPTH (m)	DEPTH (ft)
Sand	3.0	10	3.0	10
Sand and gravel, some clay	35.1	115	38.1	125
Sand and gravel	1.5	5	39.6	130
Sandy clay	7.6	25	47.2	155
Sand and gravel	.7	2	47.9	157
Cemented sand and gravel	8.5	28	56.4	185
Sand and gravel, with clay	12.2	40	68.6	225
Sand and gravel, little clay	34.4	113	103.0	338
Tight sandy clay, with some gravel	6.4	21	108.8	357
Clay and boulders	2.4	8	111.3	365
Tight sandy clay	6.1	20	117.3	385
Sand and gravel	1.5	5	118.9	390
Sand and gravel with clay	3.0	10	121.9	400
Hard sandy clay	5.5	18	127.4	418
Sand and gravel	1.2	4	128.6	422
Hard sandy clay	3.0	10	131.7	432
Clay with sand and gravel	3.4	11	135.0	443
Sand and gravel	11.9	39	140.8	462
Sand and gravel with clay	9.1	30	150.0	492
Hard sandy clay	2.4	8	152.4	500

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



Scale 1:250,000

5 0 5 10 15 20 Kilometers

5 0 5 10 15 Statute Miles

CONTOUR INTERVAL 200 FEET

WATER RESOURCES

GROUND WATER

FRESH WATER GENERALLY PLENTIFUL

1. Moderate* to large quantities of marginal to inferior quality water from unconsolidated alluvium.

FRESH WATER LOCALLY PLENTIFUL

2. Small to moderate quantities of marginal to inferior quality water from unconsolidated alluvium.

FRESH WATER SCARCE OR LACKING

3. Small quantities of marginal to inferior quality water from deposits of clays, silts, and fine sands around playas.

4. Fresh water lacking; meager to small quantities of brackish water along faults, joints, or fractures.

SPRING

WELL

*Definitions of underlined terms are as follows:

Quantity	Liters per minute	Gallons per minute
Large	400 - 4000	100 - 1000
Moderate	40 - 400	10 - 100
Small	4 - 40	1 - 10
Meager	4	1

Brackish - dissolved solids = 1500 mg/l to 15,000 mg/l

Mg/l - for the purposes of this study, milligrams per liter are equivalent to parts per million.

NOTE: Number refers to entry in table.

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

D. ENGINEERING SOILS

Soils of Fort Irwin are typical of those found in the very arid desert environment located in the Basin and Range Province of Southwestern United States. The soils can be grouped into three categories: (1) soils of the rocky, nearly barren, steep hills and mountains; (2) soils covering the alluvial deposits on terraces or terrace remnants; and (3) soils of the undrained basin floor (playas).[1]

The skeletal soils (map unit 1) covering the steep, broken hills and mountains are seldom more than 25 cm (10 in) thick. Many areas are actually devoid of soil. An estimated 30 percent of the area is rock outcrop. Wherever thin soils mantle bedrock, they consist of a high percentage of gravel or larger size rock fragments.

The most extensive soils are those that occur on the smooth, strongly sloping to nearly level terraces of pediments (map unit 2). These soils have developed from material washed down from hill areas by rains. Runoff waters become heavily loaded with soil material almost immediately. They move in a system of small, enmeshed, distributory channels rather than in definite stream courses. Most soils developed on the terraces are light brownish gray to yellowish brown, calcareous, fine sands, loamy fine sands and sandy loams. In some places caliche, a cemented layer of calcium or magnesium carbonate, has developed just below the surficial soil horizon. The hardpan is discontinuous and in areas grades into a zone of lime nodules. The soil substratum is generally comprised of coarse-and fine-grained layers or lenses of gravel, sand, and some silt and clay. Total thickness of these sandy or gravelly soils is varied. Most are many meters thick, thinning toward the steep, rough uplands.

Soils on the flat, dry, playas are usually comprised of stratified clay loam to silty clay materials many meters thick (map unit 3). Vegetation consists of a few scattered salt and alkali-tolerant shrubs and grasses along the edges. Occasionally, playas are flooded after heavy showers; the water soon evaporates leaving a dry, crusted and cracked surface.

Suitabilities for engineering and construction purposes range widely. The shallow soils of map unit 1 and the playa soils, (map unit 3), have severe limitations. The terrace soils; (map unit 2), are generally suited for many uses except where caliche is present or where slopes are locally excessive. Strong seasonal winds may cause loose, fine sand and silt to drift; dust storms are a recurrent problem.

A general soil map of an area adjacent to the southern boundary of the reservation has been prepared by the Soil Conservation Service, U.S. Department of Agriculture. The map, at a scale of 1:330,000, and an accompanying report, are useful in determining the characteristics and properties of soil likely to occur on the reservation. The user is urged to contact the Soil Conservation Service field office in Apple Valley, CA for assistance in soil-related matters.

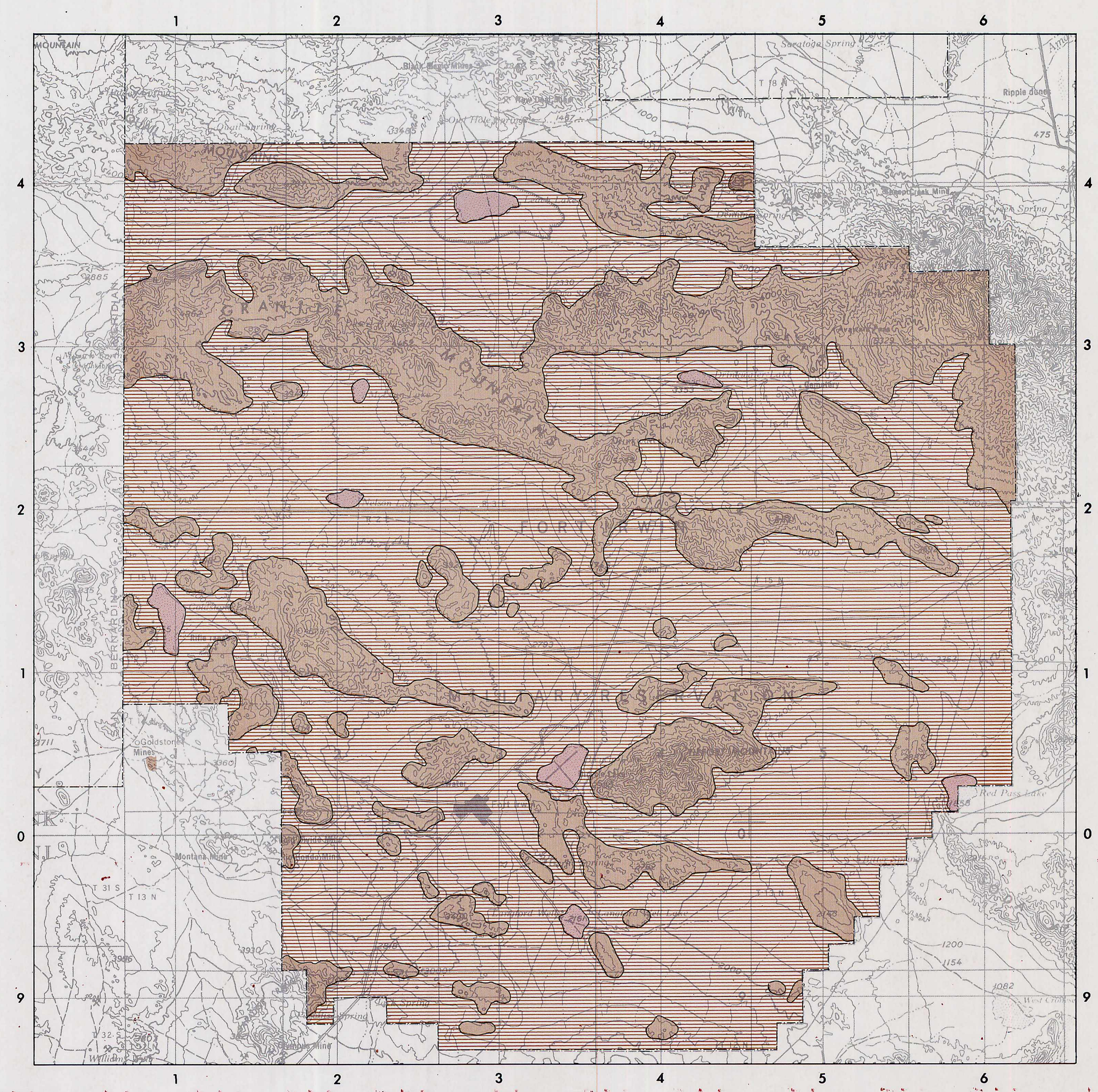
									RATING AND MAJOR LIMITING SOIL CHARACTERISTICS FOR:							
MAP UNIT	GEOGRAPHIC SETTING	TYPICAL SOIL PROFILE-LAYERS, THICKNESS OF LAYERS, DEPTH TO ROCK, UNIFIED ENGINEERING CLASSIFICATION (PROFILES NOT TO SCALE)			WATER TABLE (DEPTH AND DURATION)	PERMEABILITY	SHRINK-SWELL POTENTIAL	SEWAGE LAGOONS	SANITARY LANDFILL	SEPTIC TANK FILTER FIELD	FOUNDATIONS FOR SMALL BUILDINGS	ROAD LOCATION	SHALLOW EXCAVATION	BIVOUAC SITE	TRAFFICABILTY	REMARKS
1	Rough, barren steeply sloping hills and mountains with much exposed bedrock. Rock outcrops cover more than 30 percent of surface area. Most slopes greater than 45 percent.	0.25 m	GM, SM Bedrock	Reddish brown to yellowish brown gravelly sandy loam. Many areas devoid of soil. Pockets of deeper soil materials occur locally.	None	50 cm/hr (20 in/hr)	Very low	Not practical because of steep slopes, rock outcrops and thin soils								See section on Engineering Geology, this report.
2	Strongly sloping to moderately sloping terraces, terrace remnants, and alluvial fans. Occurs mostly adjacent to mountain and hill fronts. Slopes mainly between 10 and 30 percent. Estimated to comprise 20 - 40 percent of map unit area.	2.0 + m	GP, GM or SP	Light brownish gray to yellowish brown gravels, sand and some silts. Commonly stratified. Soil many meters thick.	None	50 cm/hr (20 in/hr) Infiltration rate reduced where 'desert pavement' occurs.	Low	Severe p, s	Severe p,s	Moderate s	Moderate s	Moderate s	Severe s	Moderate s	Slight to severe s	Locally, pebbly-gravelly ground surfaces are crusted, resulting in a condition called 'desert pavement.'
	Nearly level to gently sloping sand flats. Soils formed in sandy alluvium. Most slopes less than 5 percent. Estimated to comprise 60 - 80 percent of map unit area.	0.25 m 1.0 m 5.0 + m	SP - SM Caliche SM SP - SM GP - SM GC	Light gray calcareous or gravelly sand. Cemented lime layer (caliche) present locally. Light gray to to pale brown sand, gravelly sand and some silt and clay. Stratified. Soil many meters thick.	None	15 - 50 cm/hr (6 - 20 in/hr) Where caliche occurs, rate in surface layer much lower.	Low	Severe p	Severe p	Slight to Severe c	Slight	Slight	Moderate b	Slight	Slight	Strong seasonal winds may cause loose, sandy soil to blow and drift causing low hummocky dunes to develop on the leeward side of scattered bushes.
3	Level, mostly dry, lake beds (playas).	10.0 + m	CL or CH SM GC CL CH	Light gray, saline-alkali clays and silts. Stratified layers of sands, silts, clays, and gravels in random sequence and thickness. Soil many meters thick.	Variable	0.15 - 0.5 cm/hr (0.06 - 0.2 in/hr)	High	Severe f, w	Severe f, w	Severe f, w	Severe f, w, x	Severe f, w	Severe f, w	Severe f, w	Slight to Severe f, x	Playas may be ponded by shallow depths of water. Although the playa surface may be dry and crusted, the bearing strength of of the soil may be very low.

DEFINITIONS OF RATING TERMS	
Slight	- relatively free of limitations or limitations easily overcome.
Moderate	- limitations can be overcome with good planning and/or careful design.
Severe	- limitations are serious and are difficult to overcome.

SOIL CHARACTERISTICS AFFECTING LIMITATIONS	
b	- cutbanks cave
c	- caliche
f	- flooding potential
p	- seepage
s	- slope
w	- wetness
x	- low bearing strength

[1] Soils on the Fort Irwin reservation have not been comprehensively mapped and described. Hence, the information provided here has been interpreted from topographic maps, aerial photography, and other collateral sources. In addition, limited ground reconnaissance and soil testing was conducted by elements of the 64th and 359th Engineer Detachments.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



Scale 1:250,000

5 0 5 10 15 20 25 30 Kilometers

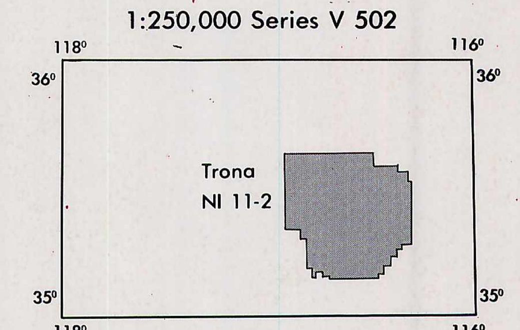
5 0 5 10 15 20 Statute Miles

CONTOUR INTERVAL 200 FEET

ENGINEERING SOILS

LOCATION DIAGRAM

1:250,000 Series V 502



1. Very shallow, stony soils on barren hills and mountains.

2. Sandy and gravelly soils on extensive terraces, fans, and nearly level sand plains.

3. Clays and silts over strata of mixed coarse- and fine-grained soils; occurs in basins (playas).

NOTE: Number refers to entry in table.

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

E. ENGINEERING GEOLOGY

Fort Irwin, California, is in the Mojave Desert section of the Basin and Range physiographic province of North America. Suitability of the area for military engineering uses is largely limited to extensive alluvial lowlands of internally drained basins interspersed among mountain ranges.

The reservation is bounded on the north by the Garlock fault zone, which passes eastward through the Quail Mountains, Leach Lake, and the Avawatz Mountains. The San Andreas fault system bounds the Mojave Desert approximately 100 kilometers (60 miles) west of Fort Irwin. Both fault systems, with other lesser faults in the area, have strongly influenced the terrain configuration at Fort Irwin.

Uplifted and tilted blocks and intruded and extruded rocks form rugged, bare uplands rising abruptly from lowlands of alluvium covering depressed or down-dropped blocks. The alluvium is basin fill deposited by glacial meltwater and precipitation runoff of both Pleistocene and Recent times, and by present-day runoff from infrequent rains. An integrated system of basinal lakes and through-flowing rivers present immediately following the glacial epochs has been segmented into isolated basins by subsequent erosion. Drainage from uplands surrounding each of the basins is entirely centripetal; none of the drainage reaches a master through-flowing stream, and most terminate in playas.

The basins are generally gently sloping fringed surfaces by rolling, more dissected topography near the uplands, culminating at the lowest points as playa flat. Unconsolidated to poorly consolidated gravel occurs nearest the uplands; silty, fine-gravelly sands make up broad lowlands transitional into saline clay/silts of the playas. All major roads and structures are in the transition zone.

The bedrock hills and mountains are highly dissected, rugged, and steep-sloped. These intrusive, extrusive, sedimentary and metamorphic rocks are essentially without soil cover and difficult of access. They are little used for military operations or construction; their only significant uses are as sources of construction materials and as sites for tunneled facilities.

Because of the greater suitability of the alluvial lowlands on Fort Irwin, these areas are emphasized on the accompanying map and table. Although the two basic categories of rock types are sand/gravel and bedrock, each can be further divided. The sand/gravel, which covers 35 to 40% of the reservation, is generally excellent for foundations, road beds, and as a source for aggregates. It is also the only category which consistently bears water. The sand/gravel ratio increases toward the playas and lowlands and decreases along the upland margins.

The bedrock varies greatly in rock type and stability. Granite appears as two distinctly different morphologies. In the northern section of the reservation, granite has been subjected to stress along the Garlock fault zone, resulting in highly fractured, friable granite with little resistance to additional stress. Orthoclase content is high, resulting in two preferential cleavage directions perpendicular to one another which should be considered in quarrying. The grânite can be used as aggregate, building stone, or rip-rap.

The arid climate of the region allows use of granite for rip-rap due to low freeze-thaw or frost-wedging rates. Foundations and roadcuts would require extensive blasting.

Schists throughout the reservation are of little engineering use. Most can support temporary, unimproved roads. High mica content and fracture density preclude other uses of the rock type.

Volcanic bedrock, predominantly andesite and basalt, is suitable for quarrying as aggregate, rip-rap, and crushed rock. Rhyolite is not suited for use as concrete aggregate due to high silica content. Foundations and roadcuts will require extensive blasting.

Fanglomerates consist of debris of variable quantity and quality. These deposits can be sites for temporary roads, but only in direction parallel to drainage pattern. Use as aggregate is dependent upon local composition and the materials will require washing.

Undifferentiated sedimentary rocks, mainly sandstone and conglomerate, are highly dissected, steep, and barren, and are of little use except as sites for jeep trails.

Playa deposits (dry lake beds, often salt-encrusted) present special engineering problems. While dry, approximately 48 weeks each year, these beds are hard and will support heavy loads and vehicular traffic. Bicycle Lake, a playa, is used as an airfield during much of the year. With precipitation, the beds become impassable and loadbearing capacity ceases. Areas are good for seasonal airfields and drop zone, but should not serve as foundations for buildings or similar structures. High clay and evaporite content preclude use as aggregate.

Ages of local rocks vary greatly. Schists in the northeast corner of the reservation are pre-Cambrian; those in the south, and the granites, are Mesozoic. The volcanic rocks are Cenozoic, predominantly Tertiary basalts and pyroclastics and Pleistocene basalts. All alluvium is Quarternary; most is Recent. There are some Tertiary nonmarine sediments along the eastern margin of the reservation.

An important consideration in the engineering evaluation of this area is the seismic activity and potential seismic risk. The Garlock fault zone, a series of ten echelon and shear coupled faults approximately 8 kilometers (5 miles) wide, is considered to be an area of great potential seismic risk. Although no historic movement has been recorded in the Fort Irwin area, investigation has shown that movement along the Garlock fault zone in Recent time (last 20,000 years) is on the order of several kilometers. The present local quiescence appears to vary from the norm for this area of the fault zone and is subject to change unexpectedly. Though there is potential for high-intensity seismic disturbance in the area, few local earthquakes have recorded intensities greater than 4.5 on the Richter scale. Records dating to the early 1800's are consistent with this information.

The geology of this area was taken from 1968 aerial photography at 1:24,000 scale and from 1970 Trona Quadrangle geology map.

MAP UNIT	TOPOGRAPHY	ROCK DESCRIPTION	PHYSICAL CONSTANTS*	ENGINEERING EVALUATION	EXCAVATION FACTORS	PITS AND QUARRIES
1. SAND/GRAVEL includes GRAVEL PAVEMENT	Flat, relatively undissected valley floors and lowland areas; moderately dissected, gentle slope areas fringing low hills; coarsely dissected steep pediments along major upland fronts. Contains drainage system in valley-floor areas and slope channels draining mountain areas. Subject to flash flooding.	Interstratified, discontinuous beds, lenses, and stringers of unconsolidated to poorly consolidated silt to gravel-sized particles derived from granite, schist, and volcanic rock. Sand to gravel ratio varies with distance from upland fronts, sand being finer in lowlands and gravel predominant along the upland fronts. Deposits 1 to 100 m (3 to 330 ft.) thick. Gravel pavement is a natural, smooth surface layer of closely packed rock fragments.	POROSITY AND PERMEABILITY: Moderate to high; highest near upland fronts. DENSITY: Moderate; increases with depth and with decrease in grain size. Due to variations in grain size and compositions, physical properties do not remain constant throughout deposit.	Cuts and fill required for road alinements will be moderate to none, increasing toward upland fronts and perpendicular to drainage patterns. Bearing capacities vary from fair to excellent depending on local composition and grain size. Most existing foundations are on sand/gravel valley fill, approximately one-third the distance upslope from playas. This area optimizes water-bearing and load-bearing potentials necessary for such utilization. Sand and gravel are fair for aggregate, but may be locally high in mica and quartz. Most areas will require washing and screening due to clay or evaporated salts. Sand and gravel are good for fill and base course, but not large enough for rip-rap. Well suited for both liquid and solid waste disposal. Disposal sites must be located so as not to contaminate local water supply.	Overburden thin to non-existent. Valley floors can be easily excavated with hand or power tools. Slope areas will be difficult to excavate due to poor sorting and slope instability. Drilling rates depend on the area. Slopes are subject to caving, slumping, and erosion and should be kept at a 2:1 or flatter slope. Drainage provisions should be made prior to excavation.	Pit sites are abundant and accessible from existing roads. On-site water may be possible with wells.
2. GRANITE	Steep-sloped rugged mountain terrain to undulating low hills or upland terrain of moderate relief with numerous rounded outcrops and boulder-strewn slopes.	Granitic rocks on Fort Irwin include quartz monzonite, granite, granodiorite, pegmatite, albite, and gneissic granite. Generally pink to gray with interlocking crystal structure containing plagioclase, feldspar, quartz, and biotite. Granitic rock in the northern portion of the reservation (Granite Mountains) is friable, highly sheared, and weathered to an unknown depth. Parallel jointing and orthogonal fracture patterns govern outcrop drainage and morphology. Granitic rocks in the southern portion of the reservation (Tiefort Mountain) are massive and lightly weathered with some fracturing. Morphology tends to be rounded and smooth; fractures are near-orthogonal where present. High feldspar content causes a predominant, near-orthogonal cleavage in two planes.	POROSITY AND PERMEABILITY: Low to moderate; increases with fracture density. SPECIFIC GRAVITY: 2.65 to 2.74 ABSORPTION: 0.3% LOSS BY ABRASION: 38 to 45% HARDNESS: 18 TOUGHNESS: 9 COMPRESSIVE STRENGTH: 957 to 1844 kg/sq cm 13,600 to 26,200 psi DENSITY: 2.71 g/cc 169 pcf SWELL: 1.74	Fair to excellent for light to heavy loads, such as foundations, but will require extensive blasting. Alinements for roads will require blasting. Local fracture patterns must be considered before blasting to maximize blast effectiveness. Granite in the southern portion of the reservation, around Tiefort Mountain, is massive and well suited for use as building stone. As aggregate for concrete and bituminous mixes, granite is fair to poor due to high silica and mica content. Fair to good for rip-rap, excellent for fill. Poorly suited for base course or railroad ballast due to interlocking crystal structure, which lowers impact resistance. Unsuited for liquid or solid waste disposal due to massive nature or rock.	Overburden thin to non-existent in hilly and mountainous terrain, extremely thick in valleys. Excavation of fresh granite will require blasting; excavation of residual granite soils is easy to difficult with hand tools. Excavations should remain stable at slopes of 1:1. Vertical cuts may be stable for short periods. Fresh, massive granite is stable in vertical cuts. Potential planes of weakness are a primary consideration in selecting a site.	Pit and quarry sites are available over most of the reservation. Access to peripheral areas generally good from existing roads. On-site water probably not available.
3. VOLCANIC ROCK	Upland flow features dissected by erosion into ridges and hills of moderate to high relief. Slopes are moderate to steep and strewn with angular cobbles and small boulders. Lava-flow features on low hills and mesas, tuff fringing ridge crests in the northwest and western central slope areas. Rhyolite, characterized by red color and quartz feldspar phenocrysts, is located in the western part of the reservation east of the Hondo Mines; basalt, andesite, and tuff are located throughout the western portion of the reservation and at Red Pass Lake.	Fine-grained red to black rock. Character varies from highly fractured to massive to vesicular. Flow structures and features such as volcanic necks, breccia, and pyroclastics are present in specific areas. Tuff beds, with little resistance to erosion, are coarsely dissected pyroclastics with horizons of large volcanic breccia.	POROSITY AND PERMEABILITY: High in fractured and vesicular rocks; ranges from 0.72% to 1.10% SPECIFIC GRAVITY: 2.40 to 2.86 ABSORPTION: 0.28 to 1.67% LOSS BY ABRASION: 14 to 18% HARDNESS: 17 to 18 TOUGHNESS: 17 to 19 COMPRESSIVE STRENGTH: 1214 to 1407 kg/sq cm 17,250 to 20,000 psi DENSITY: 2.90 g/cc 181 pcf SWELL: 1.75	Unweathered, uniform beds will support heavy loads. Fracture areas will require stabilization before supporting light to moderate loads. Basalt in the Goldstone and Red areas are especially well suited for bearing loads, but blasting may be required. Rhyolite west of Leach Lake is not suited for concrete aggregate due to high silica content, high angularity, stripping and abrasion resistance. Andesite and basalt are suitable for aggregate, but may be overly angular. All are well suited for base course. Rhyolite is unsuitable for rip-rap due to low specific gravity, and unsuitable for railroad ballast and base course due to low impact resistance. All are suitable for fill; some blending of fines will be necessary. Tuff in the central and western portions of the reservation should not be utilized for crushed rock or aggregate, due to variable chemical cômposition, alteration states and rapid alteration to clay. Massive volcanics are not suitable for waste disposal due to unpredictable fracture patterns and massive nature of the rock. Tuff is unsuited for waste disposal in most areas due to unpredictable, chaotic nature of the deposit and resulting highly variable physical properties.	Overburden thin to non-existent on hills and ridges, thickening toward valley floors. Thickness will vary with site. Excavation by hand or power tools will require heavy blasting. Stability of excavations will depend on local fracture patterns and degree of fracturing. Can be stable in vertical cuts, depending on local fractures. Support systems should be designed to local geology. Rockfalls present a possible danger. Tuffaceous members will require retaining walls or cribbing, as stability is altered by change in water content.	Quarriable sites exist throughout the southern half of the reservation, in the area west of Goldstone Lake and Red Pass Lake; most are easily accessible by existing roads. Some existing roads will require improvement or haul roads must be constructed. On-site or near-site water will be available at most sites. Volcanics in the northern half of the reservation should not be quarried unless absolutely necessary due to alteration and stress damage from local seismic activity. Tuff should not be utilized as crushed rock, due to highly variable physical constants and rapid alteration to clay.

E. ENGINEERING GEOLOGY (Continued)

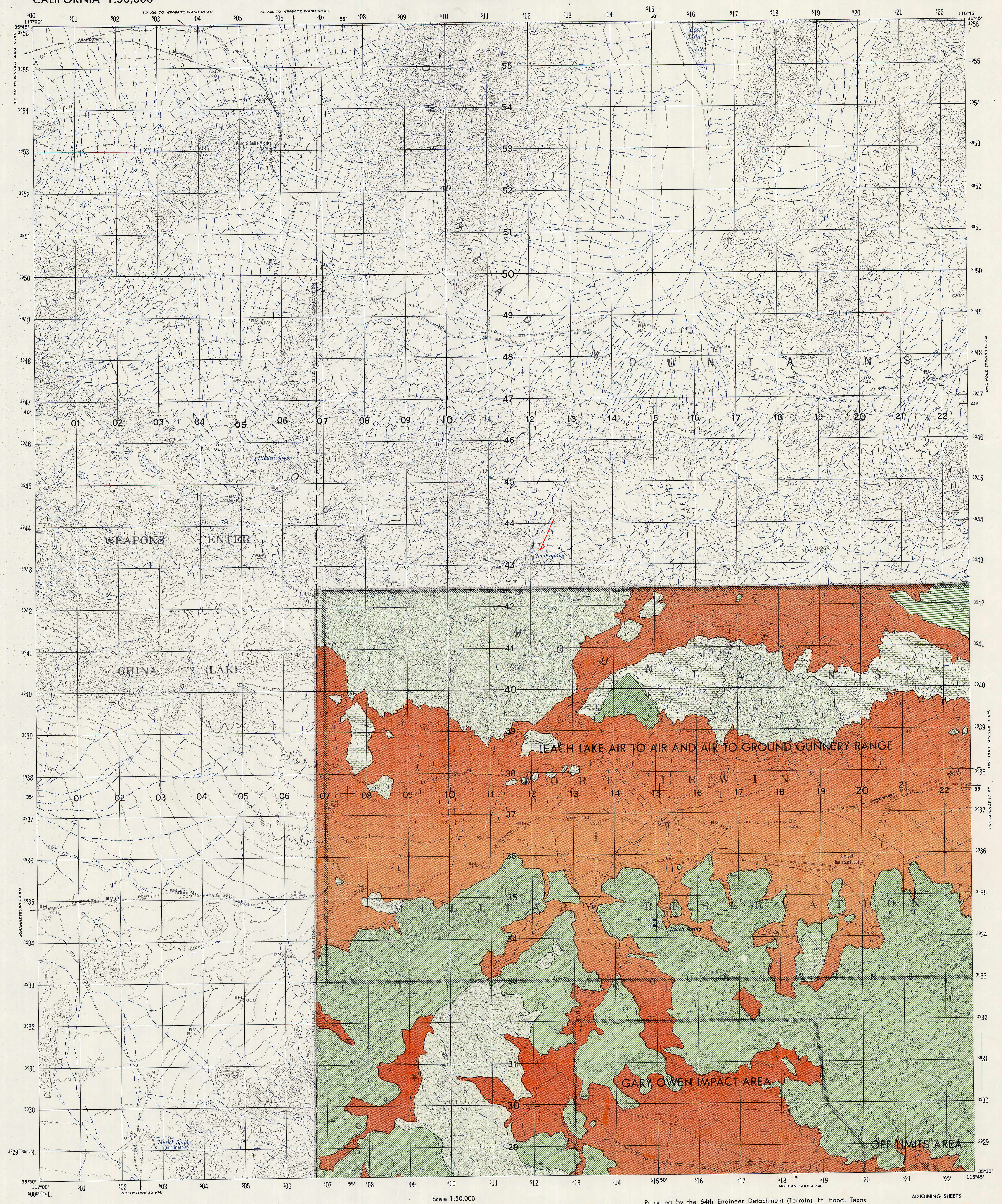
MAP UNIT	TOPOGRAPHY	ROCK DESCRIPTION	PHYSICAL CONSTANTS	ENGINEERING EVALUATION	EVACUATION FACTORS	PITS AND QUARRIES
4. SEDIMENTARY ROCKS, UNDIFFERENTIATED	Steep gravel and debris slopes are in pediment areas; material is generally coarser than that on valley floors, with a greater percentage of gravel. Dissected deposits are more prominent in northeastern Red Pass Lake Quadrangle and in Cave Mountain Quadrangle; in southern Avawatz Pass Quadrangle deposits are tilted to the southwest.	Semiconsolidated, undifferentiated sedimentary detritus. Brown to buff-colored sandstone contains sand-to cobble-sized particles. Bedding is preserved in some deposits.	POROSITY AND PERMEABILITY: Low to moderate SPECIFIC GRAVITY: 2.54 ABSORPTION: 1.8% LOSS BY ABRASION: 40% HARDNESS: 15 TOUGHNESS: 11 COMPRESSIVE STRENGTH: 450 kg/sq. cm 6400 psi DENSITY: 2.42 g/cc 151 pcf SWELL: 1.76	Sedimentary rock generally unsuitable for engineering use. Will support light loads temporarily. Steep-sided erosional boundaries of blocky uplifted or tilted deposits minimize use for roads. Loosely cemented sandstones are not suitable for use as crushed rock, due to low impact resistance. These deposits are generally poorly suited for use as concrete or bituminous aggregate due to variable physical and chemical properties. If used for aggregate, crushing, screening, and washing will probablly be necessary. Deposits are suitable for liquid waste disposal, though not as well suited as the Sand/Gravel. Unit is not suitable for solid waste disposal.	Excavation may be accomplished by both hand and power methods, but will be easier and faster with power tools. Drilling rates will be fastest using bucket drill rigs or augers and can be hampered by large cobbles and boulders throughout the deposits. Conventional ripping equipment may be used successfully for excavation. Design excavation slopes at 1.5:1 for slopes up to 16 m high. Factors which adversely affect excavation are loose, unconsolidated nature of the deposit, deformational features faults and bedding planes, and possible shrinkage of consolidated materials by 5 to 15%. Minimal support should be needed in 1.5:1 and flatter excavation slopes. Vertical slopes should be supported with concrete retaining walls or cribbing structures.	Potential pit sites are abundant; however access and actual siting may be difficult. Steep grades and deeply dissected deposits will require extensive preparatory work before excavation can begin in the Avawatz Pass and Red Pass Lake areas. Most sites are accessible from existing roads; roads may require some improvement to safely accomodate hauling equipment. On-site water is not likely. In some areas development is possible only with great difficulty.
5. SCHIST	Hill and upland terrain of intermediate to high relief, relatively coarse dissection, and rounded slopes.	Quartz-feldspar gneisses and mica schists intruded by granite dikes. Foliated, highly fractured Mesozoic metasediments. In the northern portion of the reservation, schists are altered and sheared by local seismic activity.	POROSITY PERMEABILITY: Low; dependent on local fracture pattern, increasing with density of fractures. SPECIFIC GRAVITY: 2.85 ABSORPTION: 0.4% LOSS BY ABRASION: 38% HARDNESS: 17 TOUGHNESS: 12 COMPRESSIVE STRENGTH: 929 to 1731 kg/sq cm 13,200 to 24,600 psi DENSITY: 269 g/cc 168 pcf SWELL: 1.75	Schist is suited for few engineering uses. Due to high fracture density, foliation, and mica content, schist is poor to good in load-bearing capacity. Schists in the Leach Lake and Garlock fault zone areas are poorly suited for foundations, due to alteration from fault movement. Road cuts and alignments will be difficult, requiring blasting and frequent maintenance. Due to high mica and silica content, schist is poorly suited for use as crushed rock or aggregate. For the same reasons and due to unpredicatable fracture patterns, schist is unsuited for liquid and solid waste disposal.	Thin to non-existent overburden; excavation will require power tools and blasting. Stability depends on local fracture patterns and can be stable in vertical slopes. Support systems will be necessary for excavation. Emphasis should be given to orientation and degree of fracturing with respect to orientation of excavating face. Rockfalls and bursts are possible.	Possible sites in Quail Mountain, Leach Lake, and Alvord Mountain Quadrangles, close to or accessible by existing roads. On-site water probablly not available.
6. FANGLOMERATE	Coarsely to moderately dissected slope areas fringing low hills and adjacent to upland fronts. Drainage channels, generally parallel to one another, may be subject to flash flooding.	Poorly bedded, poorly sorted andesite, granite, and gneissic granite gravels, cobbles, and boulders derived from former and existing upland and mountain fronts.	Due to highly variable compositions, grain size, and alteration states, physical properties are not consistent and cannot be quantified.	Fanglomerate is poorly suited for most engineering uses, due to highly variable composition grain size and rock type vary throughout a single deposit and among various deposits. Fanglomerate will temporarily support light loads and foundation. Coarse dissection precludes construction of roads. Jeep travel is possible parallel to drainage pattern. Travel perpendicular to drainage will require extensive cut and fill. Use as crushed rock is discouraged. Deposits consist of various rock types of differing alteration states; screening, crushing, and washing would be necessary. Disposal of liquid or solid wastes is not recommended. High permeability rates and location of deposits would allow easy escape and contamination of aquifers. Solid waste would be dissolved by precipitation and subsequently contaminate aquifers.	Overburden thin to non-existent. Ease of excavation varies with site; excavation with power tools or blasting recommended. Slopes of 1:1 or flatter recommended; shoring and retaining walls will be needed in some areas. Drainage should not be allowed to contact excavated gravels as lubricated, unstable deposits may flow down slope.	Pit sites are available in Lane Mountain, Alvord Mountain, and Tiefort Mountain Quadrangles. Access to areas containing deposits is moderate to good; access to individual deposits is poor and construction of haul roads will be difficult. Near-site water may be possible with wells; no on-site wells possible.
7. PLAYAS	Isolated seasonal lakes on valley floors. Level basinal features of terminal drainage.	Silts, clays, and fine evaporites deposited from evaporating seasonal lakes enriched with dissolved solids. During most of the year the area is dry and compact; when wet from seasonal rains all strength and rigidity is lost.	POROSITY: Low PERMEABILITY: Low ABSORPTION: High LOSS BY ABRASION: High TOUGHNESS: Low COMPRESSIVE STRENGTH: Moderate to low when dry; Low when wet	Due to high clay and silt content, playas have little engineering use. Though hard and compact when dry, these deposits become extremely plastic when wet. During dry seasons playas may be used as airfields, unimproved roads, and temporary foundations. When wet, all load bearing capacity is lost until unit is dry to a depth of several feet. Improved roads, airfields, or permanent foundations would suffer major damage during a wet period. Aircraft or vehicles utilizing these facilities during wet periods would also sustain major damage. Playa clays and silts are not suitable for use as aggregate or crushed rock due to high clay content, low impact resistance, and lack of consolidation. Low porosity and permeability preclude use for liquid waste disposal. High swell rates and uncertain basal conditions preclude solid waste disposal.	Excavation should be easy with hand or power tools during most of the year. Wet weather excavation will be most easily accomplished with power equipment, but special care must be taken to avoid miring equipment.	Abundant sites exist in many areas throughout the reservation. Access to playas is good to excellent along existing roads. Near-site water will be available with wells. On-site water probably not available.

* All numerical values are average values taken from numerous samples of the given rock type. They are not values from rock at Fort Irwin.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2655 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2555 I	2655 IV	2655 I
2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I

ENGINEERING GEOLOGY

SOME ENGINEERING USES

1
- SAND/GRAVEL – Sand, clay and gravel with particle size increasing toward upland fronts, high clay content near playas.
- GRAVEL PAVEMENT – Low near level deposits of gravel and cobbles covered with desert varnish.

FEW ENGINEERING USES

2
- GRANITE – Hills of highly fractured and friable granite, weathered to an unknown depth.
- GRANITE – Uplands of massive, shallow weathered granites; near orthogonal fracture system.

3
- VOLCANIC ROCK-MASSIVE – Massive somewhat jointed and fractured, lightly weathered rhyolite basalt and andesite uplands.
- VOLCANIC ROCK-TUFF – Pyroclastic debris ranging from ash to blocks.

4 SEDIMENTARY UNDIFFERENTIATED – Uplands of coarsely dissected, poorly to moderately consolidated sandstones and conglomerates with limey matrix.

5 SCHISTS – Uplands of schists and metasediments moderately to lightly altered, fractured and foliated, high mica content.

6 FANGLOMERATE – Very coarsely dissected deposits of breccia, boulders and gravel derived from upland fronts.

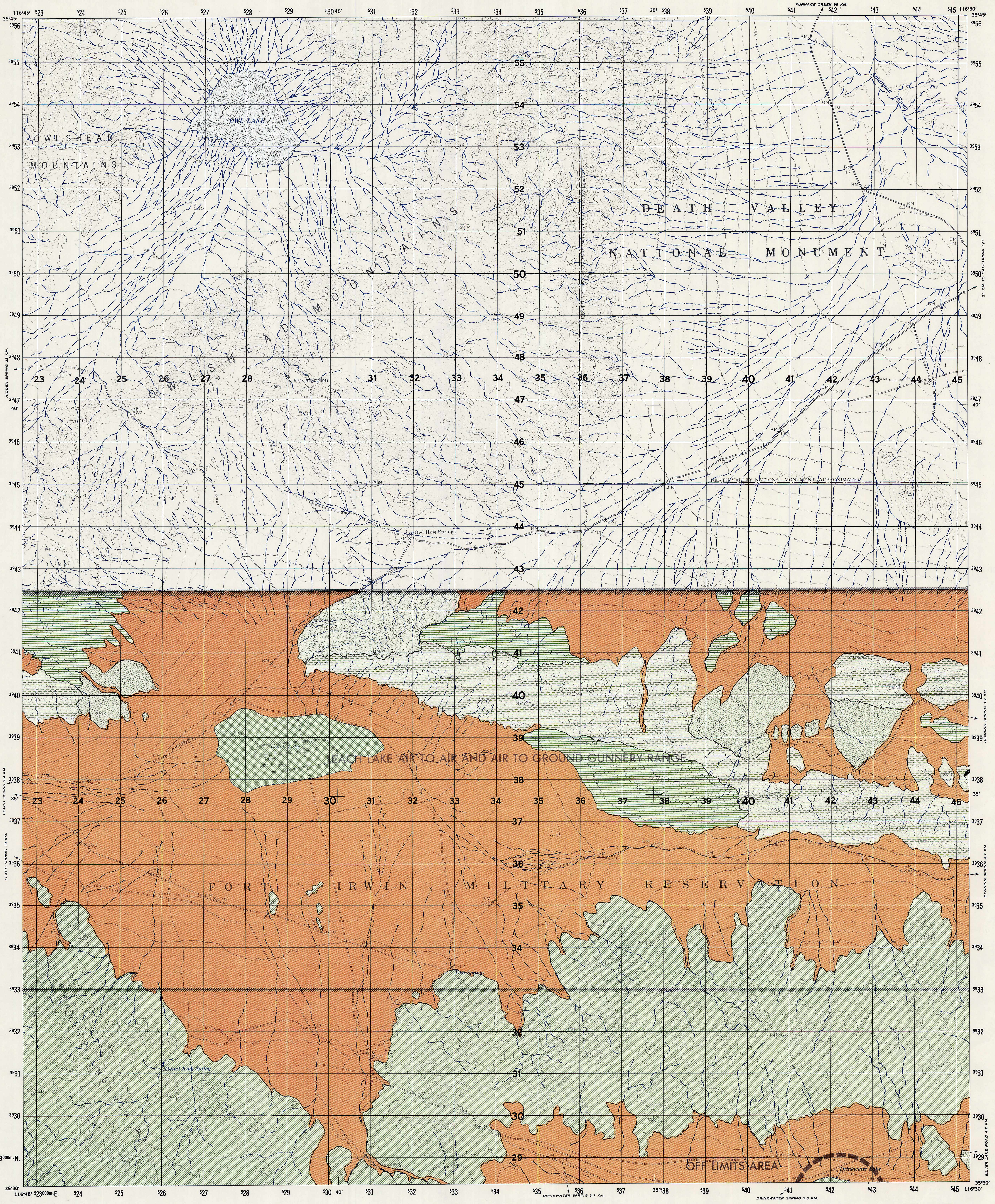
7 PLAYAS – Dry lake beds, wet only three or four weeks each year, with high clay/silt and evaporated salt content.

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2655 II



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2655 IV	2655 I	2755 IV
2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV

ENGINEERING GEOLOGY

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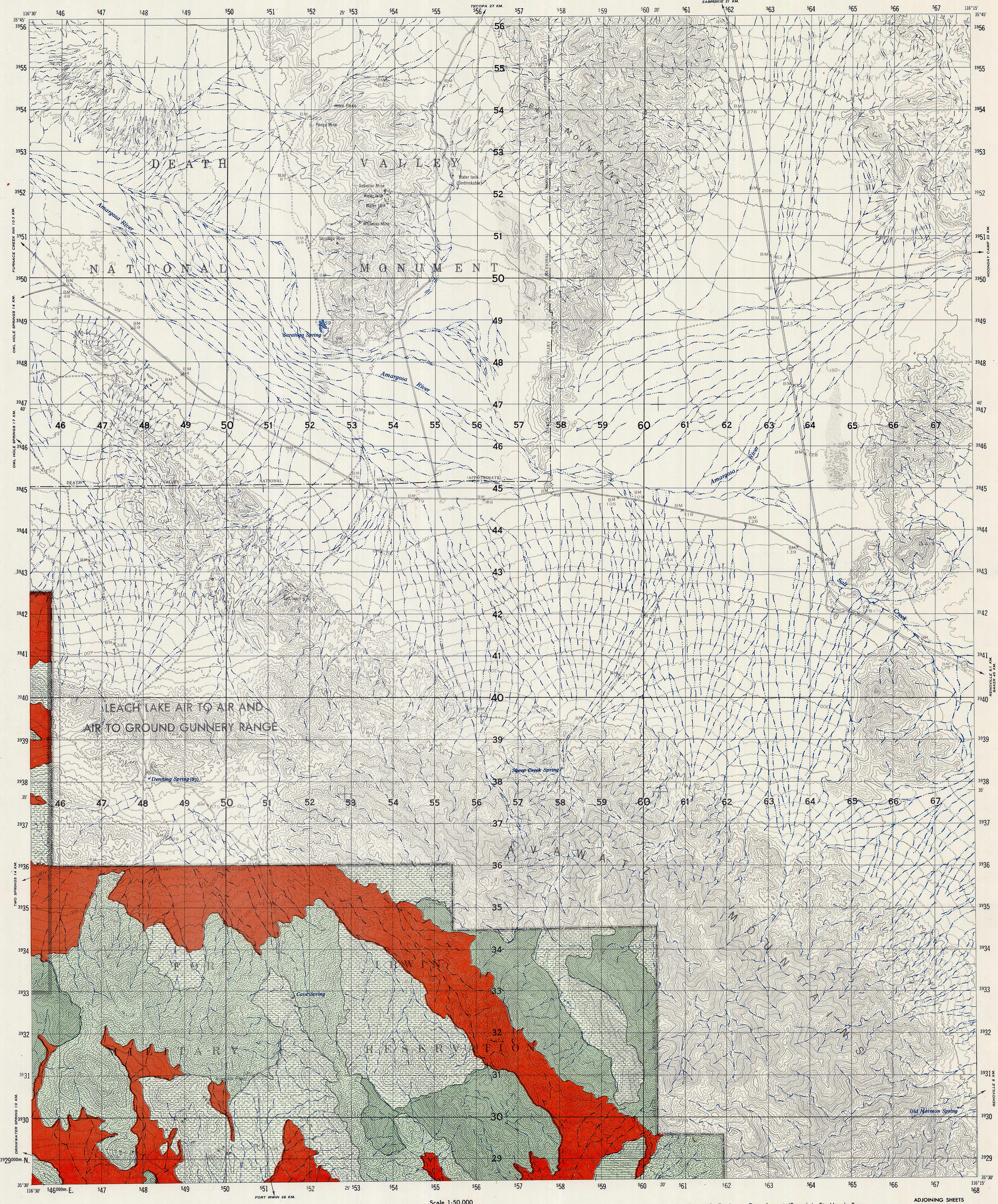
FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2655 I	2755 IV	2755 I
2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I

ENGINEERING GEOLOGY

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FEW ENGINEERING USES

2 — GRANITE – Hills of highly fractured and friable granite, weathered to an unknown depth.

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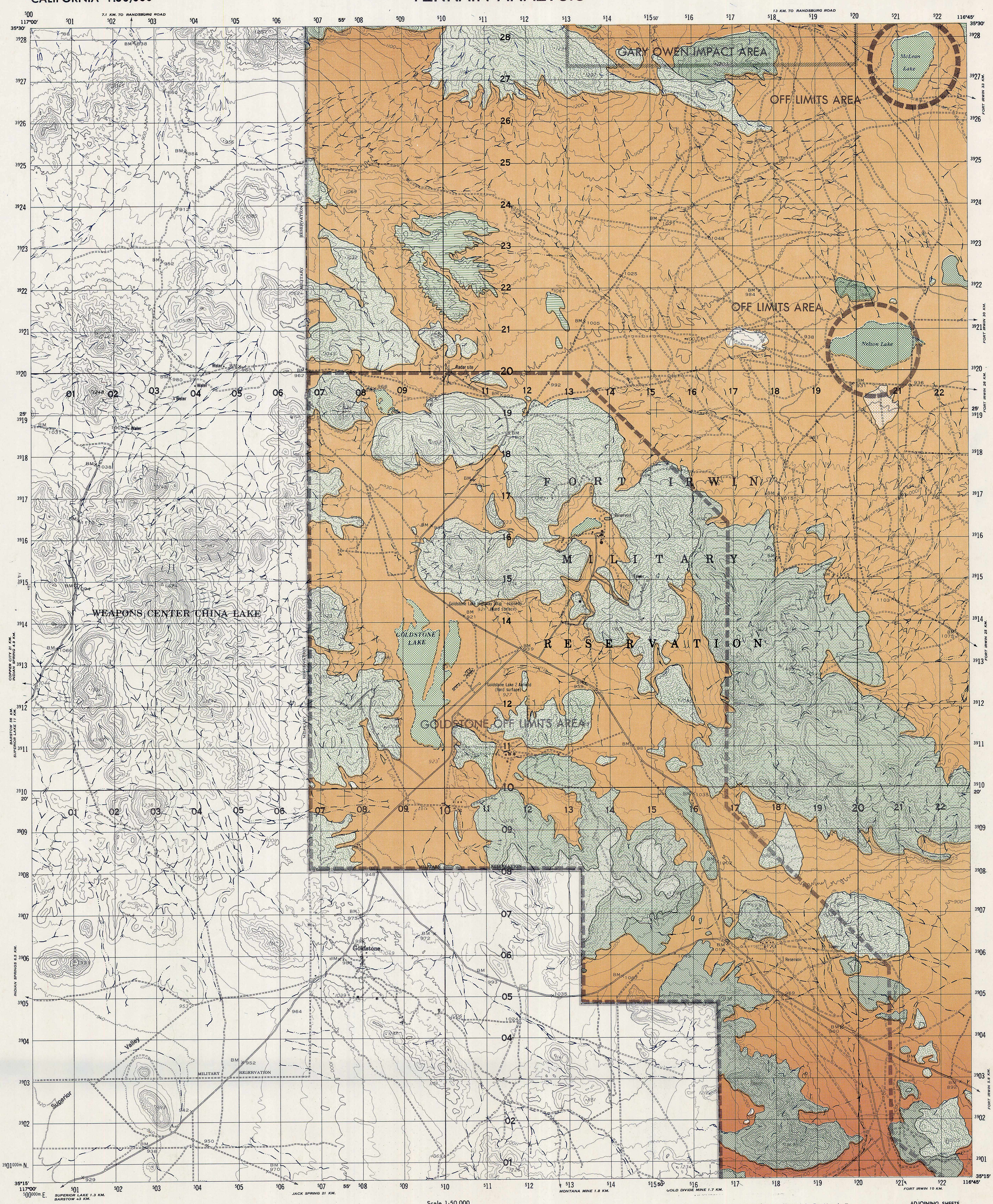
FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II

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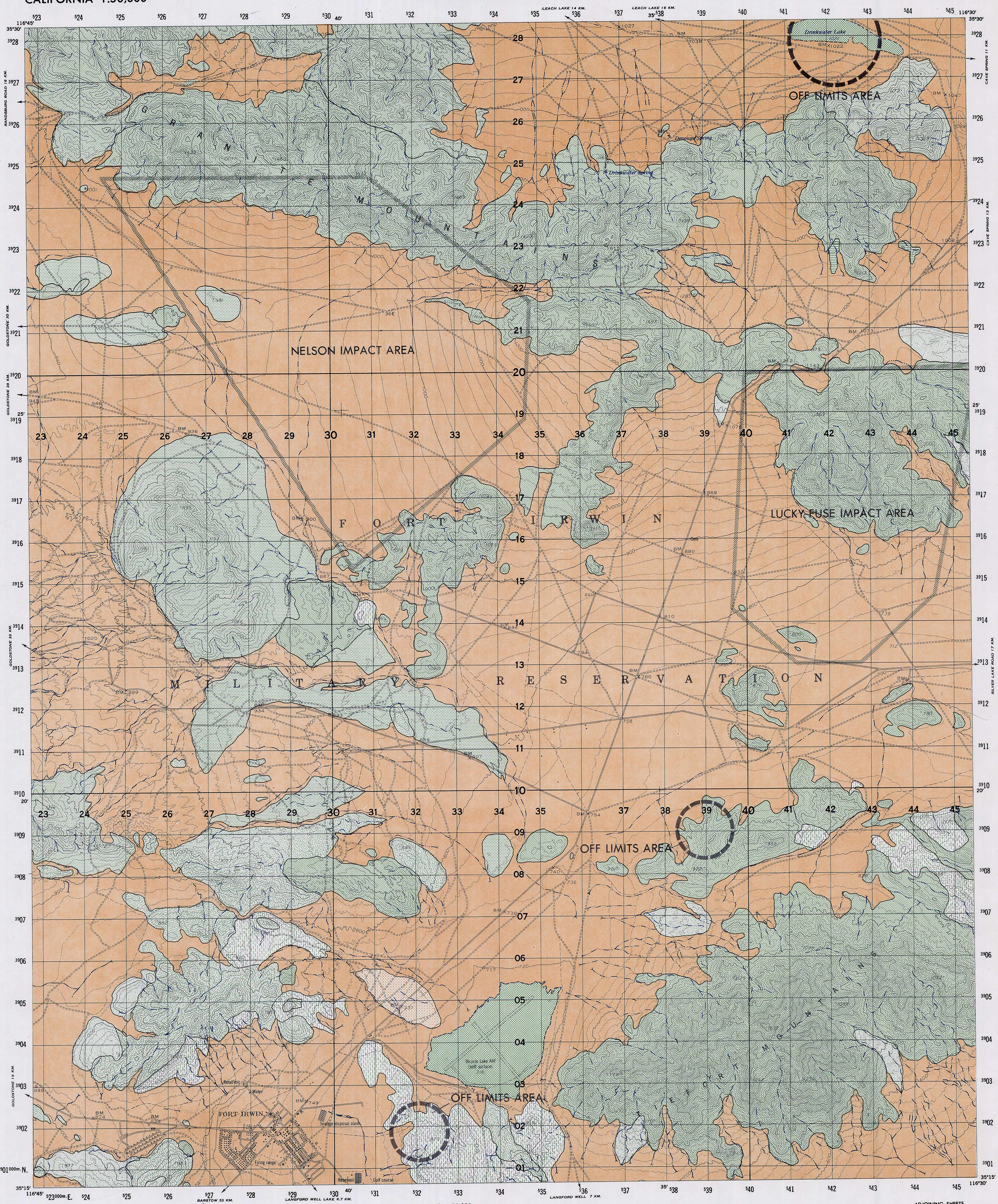
FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 I



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1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III

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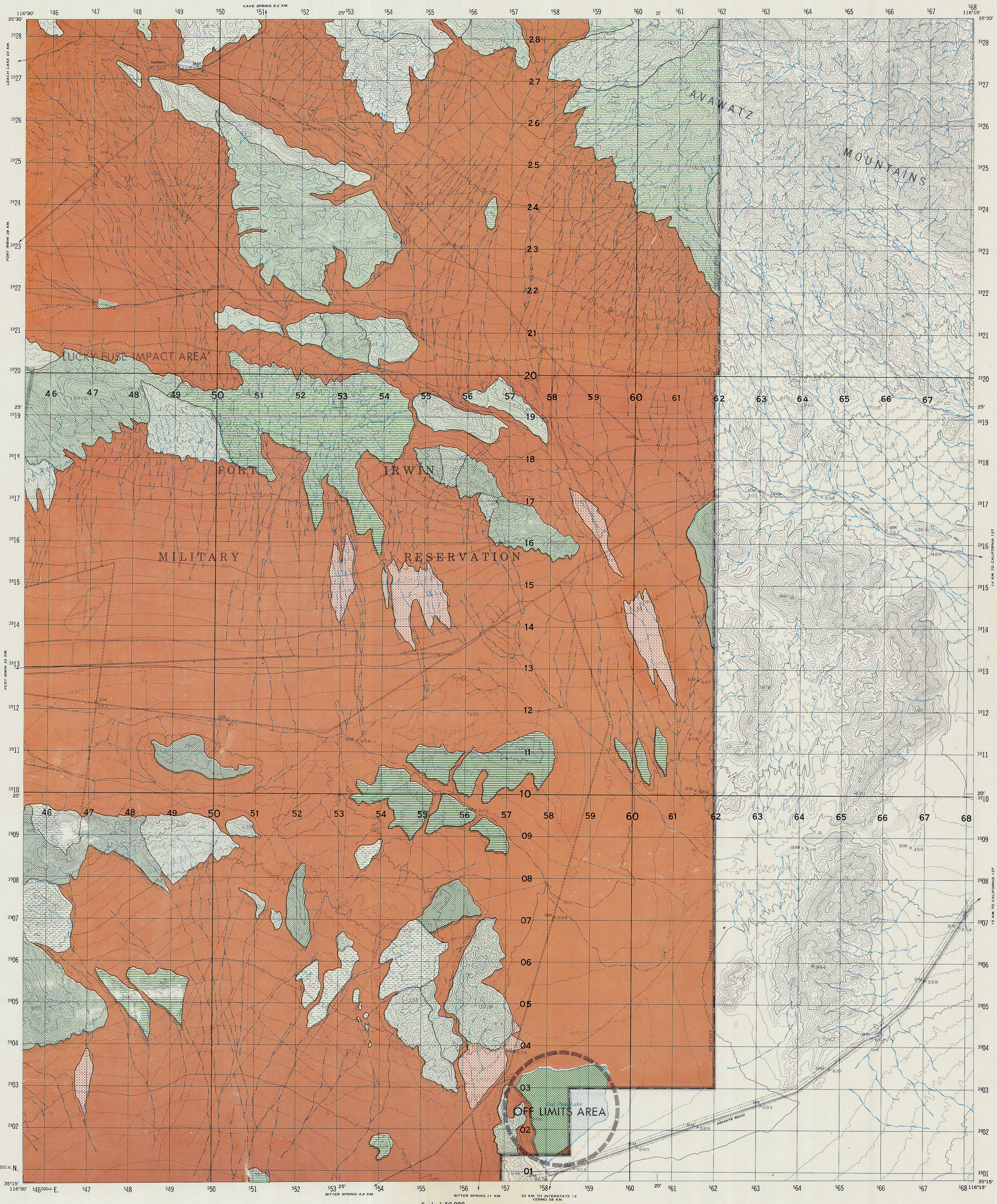
FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 IV



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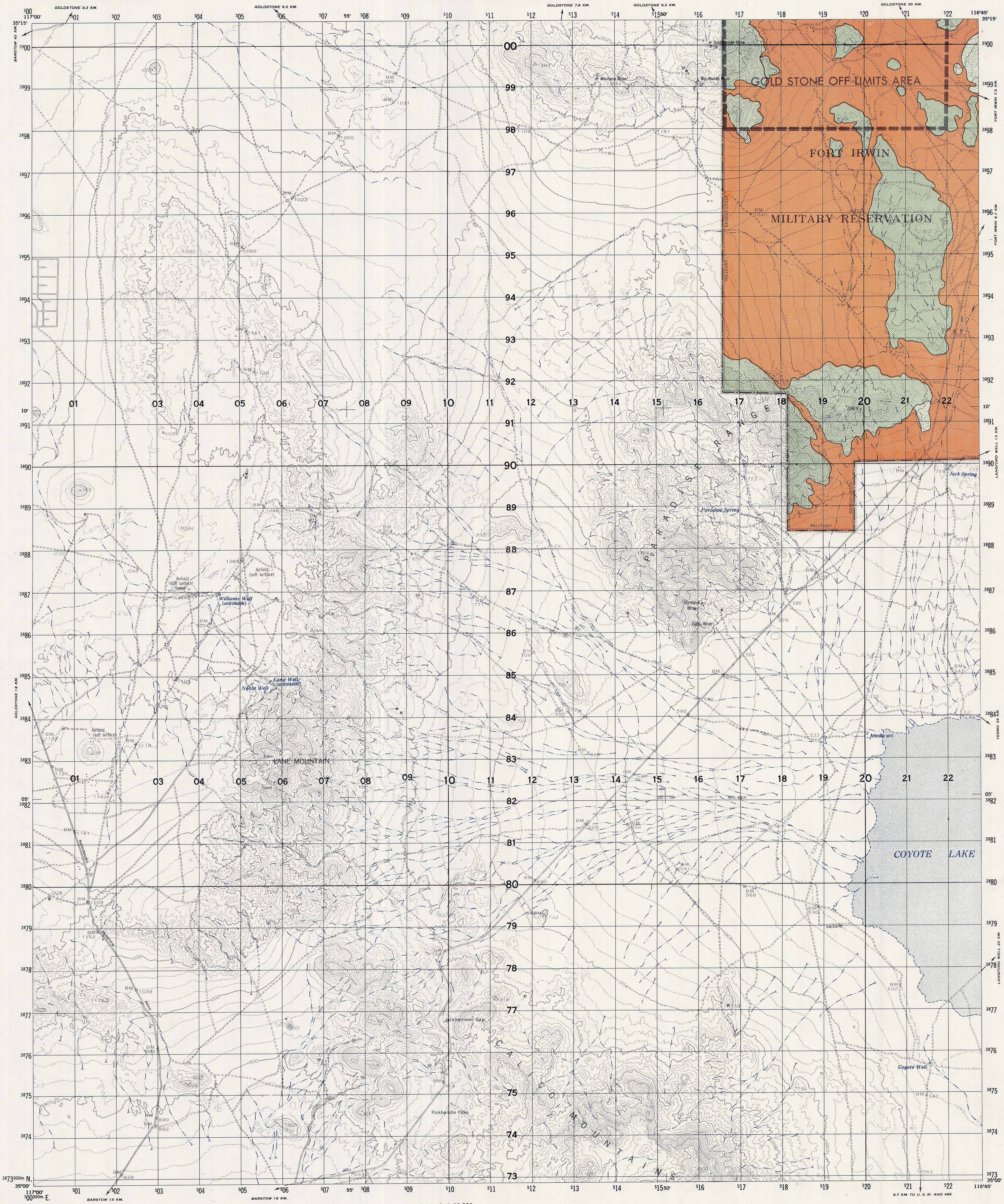

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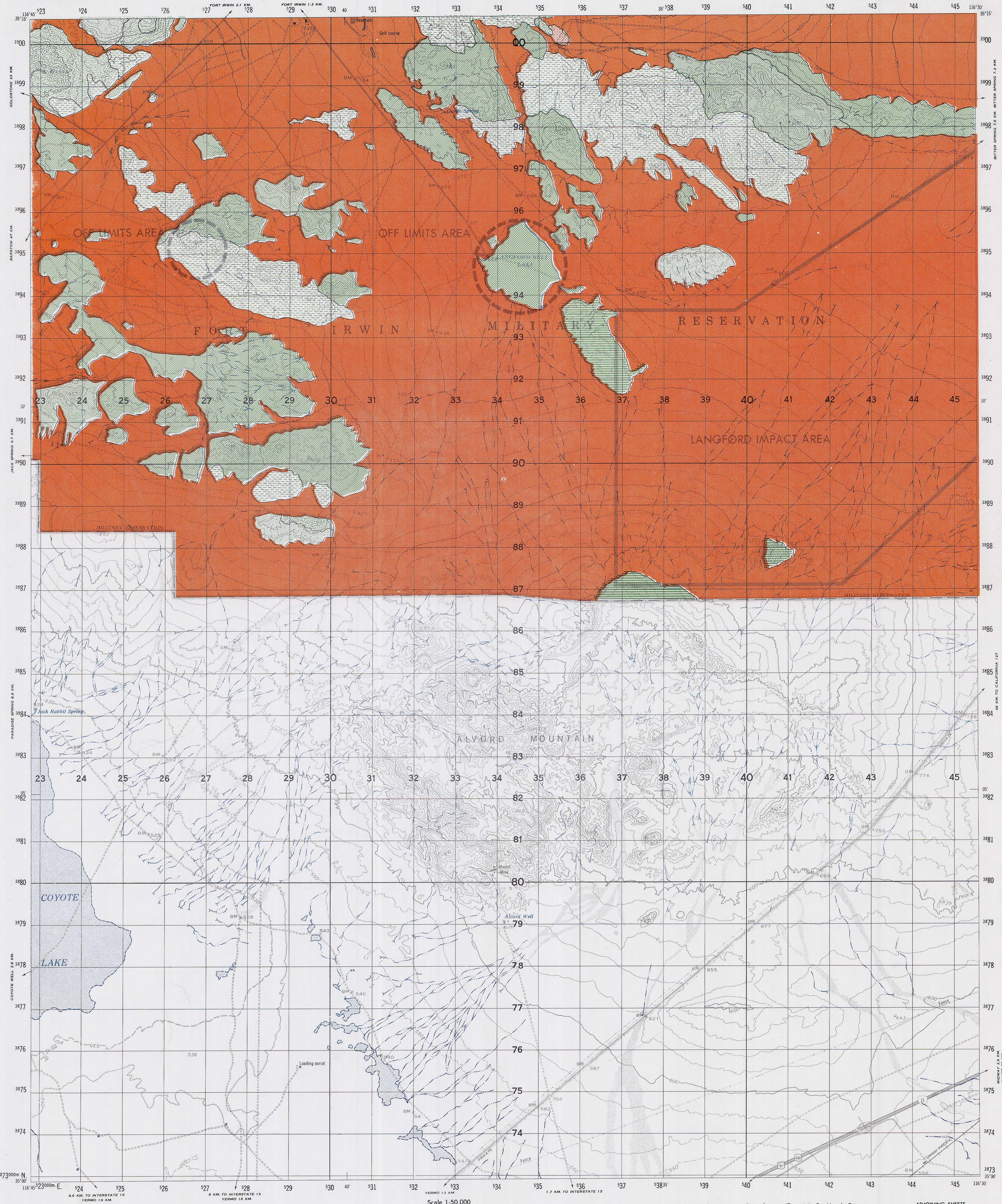

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

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2654 IV	2654 I	2754 IV
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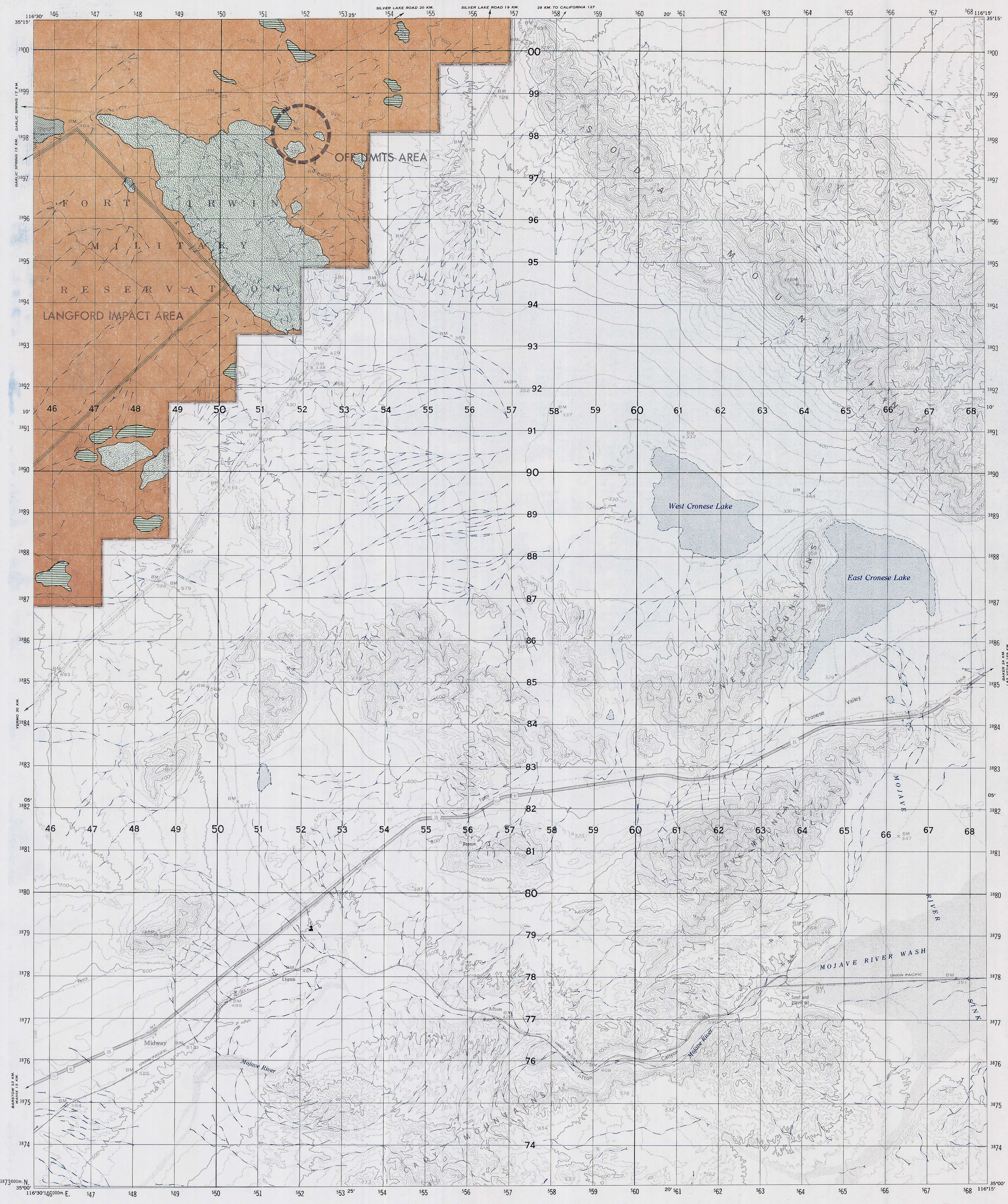
FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 III



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F. SPECIAL PHYSICAL PHENOMENA

1. FAULTS AND RELATED EARTHQUAKES

Seismic activity at Fort Irwin is directly related to faults in the area. Most recent earthquakes registered less than 4.5 on the Richter scale and resulted in negligible ground acceleration at Fort Irwin. Faults in the area have two main characteristics: the components of movement are predominantly horizontal rather than vertical, resulting in strike-slip or lateral faults; and they yield frequent, shallow, low-magnitude earthquakes. These characteristics do not preclude the possibility of a major quake in the area, however, the general nature of 'fault creep' in Southern California makes a major quake less likely.

The Garlock fault zone, a system of northeast- and east-trending en echelon and shear-couple faults averaging 11 kilometers (6.85 miles) wide, contains displaced Mesozoic granites and metasediments, Miocene and Tertiary volcanics, and Quaternary sediments. Fault traces are most visible in the volcanics and metasediments and are steep, straight and clearly defined for air or ground observation. Total displacement along the Garlock fault zone is estimated from 9.6 to 64 kilometers (6 to 40 miles), in Mesozoic intrusives with displacement of up to 0.8 kilometers (0.5 miles) in recent sediments. Recent movement in the Leach Lake area is estimated from 5 to 46 meters (15 to 150 feet) with between 2000 and 200 years since last movement. Movement is predominantly left-lateral, though minor associated normal faulting is common. Though there have been no historic quakes along the Garlock fault zone on Fort Irwin, recent studies show that in the past, movements have been frequent along the faults. Well-preserved fault evidence is visible in the Leach Lake - Avawatz Pass area. The resulting hypothesis states that although the fault is now inactive in this region, it may resume activity suddenly, with little warning. Quakes may be up to 7.5 Richter magnitude. Movement recorded along the Garlock shows that repeated episodes of movement occurred along the same breaks, but this does not guarantee that no new breaks will occur on presently unbroken ground. Movement along nearby faults implies that forces capable of causing movement along the Garlock zone still exist in the area. Engineers and planners should refer to Clark, USGS Miscellaneous Geologic Investigation No. 741, 1973 for further information.

The San Andreas fault, 136 kilometers (85 miles) southwest of Fort Irwin, is a southwest-trending strike-slip fault with right-lateral movement. Activity along the southern portion of the fault results in frequent, small movements yielding faint tremors in the Fort Irwin area. The Manix and Emerson faults, 32 and 80 kilometers (20 and 50 miles) south of Fort Irwin, respectively, also have historic records of earthquakes. A quake from the Manix fault in 1947, registering 6.2 Richter magnitude, produced a ground acceleration of 22% gravity at Fort Irwin.

The Lockhart fault, 55 kilometers (35 miles) southwest of Fort Irwin has exhibited fault creep - a uniform, slow displacement with no appreciable earthquakes. Other potentially active faults on the reservation have no recorded historic displacement, though most have displaced Quaternary sediments.

California Division of Mines and Geology in "Seismic Safety Information 1972 - 1974" has placed Fort Irwin in the A and B intensity zones of seismic activity (zone A is characterized by one to five seismic occurrences of intensities VI, VII, or VIII on the Modified Mercalli scale between 1810 and 1969; zone B by six to ten occurrences of the same intensities over the same period). The reservation is in zone 3 of the "Earthquake hazards in the U.S." map of the Earthquake Information Center. Zone 3 is described as the area where "Major destructive earthquakes may occur." In the period between 1932 and 1974, 38 earthquakes with Richter magnitudes greater than 5 were recorded within a one-hundred mile radius of Fort Irwin. Four of those earthquakes exceeded 6 on the Richter scale.

2. SHEET AND LOCAL FLASH FLOODING

Lack of vegetation and extreme differences in infiltration rates of adjacent strata, in conjunction with locally heavy rain, can result in local flooding of ephemeral stream channels. Sheet flooding in areas of gravel pavement and playa flooding also follow heavy rains. Engineers and planners should investigate local flooding before site selection. Military operations in flooding areas should be carefully monitored, as tentage, vehicles, and foot troops may sustain damage from flood waters. Flooding occurs occasionally throughout the year, usually during the summer months, and is more dependent on the rate of rainfall than on the actual amount.

G. VEGETATION

Creosote bush scrub, transitional shrubland, shadscale scrub, and alkali sink comprise four vegetative communities on Fort Irwin. The vegetative cover is of little military significance, low-growing and generally widely spaced, exposing sand, gravel and bedrock surfaces. No vegetation map is provided for this topic.

The creosote bush scrub community covers the largest area and generally grows between 610 and 1250 meters (2000 and 4100 ft) above sea level. The creosote bush, the dominant species, is generally between 1.2 and 2.4 meters (4 and 8 ft) in height, but may attain a height of over 3 meters (10 ft). The creosote bushes are generally spaced 3 to 3.7 meters (10 to 12 ft) apart. Other smaller shrub species, associated with the creosote bush, are low-growing bursage, cheesebush, and hopsage. Additionally, desert needle grass, Indian ricegrass, malpais bluegrass, and squirreltail grass are the common grasses within this community. The Joshua tree woodland, which is subdominant in the creosote bush scrub community, grows in the southwestern portion of Fort Irwin. The Joshua trees are protected under federal law. These trees are widely spaced and low-growing. Though concealment and cover is largely non-existent, some concealment from ground observation may be available for the individual soldier by larger creosote bushes.

The transitional shrubland community occurs throughout the higher hills and mountains, from the top edge of the pediments to the hill and mountain summits. The predominant shrub species at the lower elevations are low-growing creosote bush, bursage, Nevada Mormon tea, and cheesebush. The dominant shrubs at the higher elevations are California buckwheat and Mormon (mountain) tea. Other shrubs such as boxthorn, hopsage, Mojave horsebush, goldenbush, allscale saltbush, and bladdersage occur throughout the range of elevations, 854 to 1585 meters (2800 to 5200 ft). Dominant species are spaced approximately 0.6 meters (2 ft) apart and are 1.2 to 1.8 meters (4 to 6 ft) in height. Large clumps of desert needlegrass can be found among rocks and scattered large areas of malpais bluegrass occur on some north-facing slopes.

The shadscale scrub community is found between elevations of 396 and 744 meters (1300 and 2440 ft). The vegetation is extremely sparse, with the primary species being desert holly and shadscale. Bursage and ink weed also occur. Dominant species are spaced approximately 9.1 meters (30 ft) apart and are 0.6 to 0.9 meters (2 to 3 ft) in height. Grasses, perennial forbs, and cacti are seldom present and rarely occur in this community.

The alkali sink communities are situated on poorly-drained, highly alkaline soils where elevations generally range between 762 and 793 meters (2500 and 2600 ft). Allscale saltbush is the predominant species. Dominant species are spaced approximately 4.3 meters (14 ft) apart and are 1.2 to 1.8 meters (4 to 6 ft) in height. Other common low-growing species are shadscale, goldenhead, boxthorn, Indian ricegrass, Arabian grass, and bursage. Several barren areas occur on Fort Irwin but particularly in the many playas (dry lakes) which are virtually devoid of vegetation.

The vegetation cover on Fort Irwin affords virtually no concealment from aerial or ground observation for foot troops or vehicles, with the exception of the limited concealment the creosote bush scrub community provides. Cover from flat-trajectory fire of small arms for foot troops is non-existent in these desert vegetation communities.

H. CLIMATE

Fort Irwin is located in the northeastern Mojave Desert region of southern California, and has a typical semi-arid climate, with prevailing clear skies and warm to hot temperatures.

Winter is characterized by cold nights and cool days with average daytime temperature maximum of 14° C (57° F) in the coldest month, January. The lowest temperature reached over a 12-year record period was – 11.7° C (11° F), but the mean daily minimum in the coldest month is only slightly below freezing. Rather high wind speeds have been recorded; equivalent wind chills approaching – 40° C (– 40° F) are theoretically possible. However, wind chills of – 13.5° C (7.7° F) are more typical of coldest winter days, and thus low temperatures do not constitute an outstanding hazard to personnel at Fort Irwin who are adequately clothed.

Summer is a time of hot, dry, dusty days and relatively cool nights. On average, 60 of the 62 days of July and August exceed 32.2° C (90° F), while the highest temperature over a 12-year period of record was 45.6° C or 114° F. In the warmest month, July, the night temperatures drop to a minimum of about 22.2° C (72° F). Mornings are calm in the desert summer, but by afternoon the dry heat is usually accompanied by southwesterly winds blowing at 10 to 20 knots, and gusting up to 50 knots. Although the sky is generally clear, the rapid heating, unstable lapse rates and the high winds combine to produce large amounts of airborne dust and sandblast effects near the ground.

Fierce summer temperatures at Fort Irwin would indicate that this is an area of medical hazard for heat injuries. However, such effects on personnel are not a result of dry bulb temperature alone, but of the combination of effects from heat, humidity, solar radiation, wind and the added load of internal heat production caused by physical work or exercise. The WBGT (wet bulb globe temperature) is the index prescribed by current military medical doctrine (TB Med 175) to measure the combined effects of temperature, radiation, humidity and wind. At Fort Irwin in summer, WBGT readings exceeded 85° F (the level at which strenuous training is normally suspended even for fully acclimated troops) about 10 days in an average summer, and it occasionally reaches 90° F, the point at which even light physical activities by acclimated men is medically inadvisable.

Annual precipitation at Fort Irwin is 64.3 millimeters (2.53 inches), more than half of which falls in the December-February quarter. The record year's rainfall, during 11 years, was about 178 millimeters (7 inches). Snowfall averages a mere 10.2 millimeters (0.4 inches) per year, with absolute maximum accumulation of 102 millimeters (5 inches). In the dry summers, the scant rainfall is often in the form of thunderstorms, normally about one in six weeks in July and August. June is the driest month, and in the 11 years of record, no June rainfall exceeded 3.3 millimeters (0.13 inches).

Spring and autumn are transitional between winter and summer and constitute a near-linear increase/decrease in temperatures, precipitation, humidity, wind speed, etc. Frontal systems pass through this area at high speeds, averaging about 25 knots. Winter winds averaging some 12 knots are slightly slower than in summer, although gusts can reach 70 knots. Strong westerly winds can be sustained at 20 to 35 knots for up to 24 hours.

Flying weather is good year round except for high velocity surface winds, causing turbulence during take-off and landing. Clear days average 350 per year. The highest probability of ceilings less than 1,524 meters (5,000 feet) occurs in January and February, with an average of three days each month. Visibility averages more than three miles on 360 days each year and can be 80 to 160 kilometers (50 to 100 miles) much of the year. November through March have the highest likelihood of poor visibility - which still averages less than one full day in any month. The major cause of poor visibility and lowered ceilings is airborne dust. Poorest daily conditions occur in the afternoon and early evening, due predominantly to airborne dust and increased wind speed.

CLIMATIC SUMMARY*

FORT IRWIN, CALIFORNIA LATITUDE 35° 16′ N. LONGITUDE 116° 41′ W. ELEVATION 748.6 M. (2456 FT.)

PARAMETER	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Absolute maximum temperature	°C	23.3	26.7	30.0	35.6	41.7	45.6	45.0	43.3	43.3	37.2	29.4	23.9	45.6	12
	°F	74	80	86	96	107	114	113	110	110	99	85	75	114	12
Mean daily maximum temperature	°C	13.9	17.2	20.6	25.6	29.4	35.6	39.4	37.8	34.4	27.8	20.0	15.6	26.7	12
	°F	57	63	69	78	85	96.1	103	100	94	82	68	60	80	12
Mean daily minimum temperature	°C	0.6	2.2	5.0	9.4	13.3	18.3	22.2	20.6	16.7	10.6	3.3	-0.6	10.0	12
	°F	31	36	41	49	56	65	72	69	62	51	38	31	50	12
Absolute minimum temperature	°C	-11.7	-7.8	-4.4	-2.2	3.3	5.6	12.8	11.7	7.8	0.6	-6.7	-9.4	-11.7	12
	°F	11	18	24	28	38	42	55	53	46	33	20	15	11	12
Mean number of days with maximum temperature 90°F (32.2°C)		0.0	0.0	0.0	2.5	11.4	23.1	31.0	29.8	23.2	6.8	0	0	127.8	12
Mean number of days with minimum temperature 32°F (0.0°C)		18.4	9.1	3.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	6.2	20.2	57.6	12
Normal heating degree days (base 65°F/18.3°C)†		598	416	326	164	27	0	0	0	0	88	342	586	2547	29
Normal cooling degree days (base 65°F/18.3°C)†		0	0	6	74	176	380	617	558	351	110	0	0	2272	29
Mean dew point temperature	°C	-2.8	-2.2	-2.2	-0.6	1.7	2.8	6.7	6.1	3.9	0.6	-2.2	-3.3	0.6	12
	°F	27	28	28	31	35	37	44	43	39	33	28	26	33	12
Mean Relative-Humidity	%	56	47	38	33	29	23	24	25	28	31	43	52	36	12
Mean Pressure Altitude‡	ft	2160	2205	2267	2301	2350	2374	2367	2362	2352	2276	2186	2149	2279	
Mean monthly precipitation	mm	16.3	10.2	6.1	3.6	0.5	0.8	0.8	1.3	6.4	1.3	7.9	9.4	64.3	12
	in	0.64	0.40	0.24	0.14	0.02	0.03	0.03	0.05	0.25	0.05	0.31	0.37	2.53	12
Absolute maximum monthly and annual precipitation†	mm	25.4	55.9	18.5	26.2	11.9	3.3	21.3	12.2	40.1	20.6	70.0	43.7	178.8	11
	in	1.00	2.20	0.73	1.03	0.47	0.13	0.84	0.48	1.58	0.81	2.79	1.72	7.04	11
Absolute minimum monthly and annual precipitation†	mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.2	11
	in	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.82	11
Absolute maximum 24-hour precipitation†	mm	43.9	48.5	27.69	10.67	8.64	4.32	18.29	13.21	36.07	31.24	40.13	38.1	48.5	20
	in	1.73	1.91	1.09	0.42	0.34	0.17	0.72	0.52	1.42	1.23	1.58	1.50	1.91	20
Mean number of days with thunderstorms		0.0	0.0	0.1	0.1	0.3	0.2	0.7	0.7	0.4	0.2	0.1	0	2.8	12
Mean monthly snowfall	mm	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12
	in	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	12
Maximum monthly snowfall recorded	mm	254.0	61.0	86.4	30.5	7.6	0.0	0.0	0.0	0.0	0.0	233.7	198.1	254	20
	in	10.0	2.4	3.4	1.2	0.3	0.0	0.0	0.0	0.0	0.0	9.2	7.8	10	20
Mean number of days with precipitation 0.1 inches (2.5 mm)		1.7	1.0	0.7	0.3	0.1	0.1	0.1	0.1	0.5	0.2	0.7	1.2	6.7	12
Percent frequency of surface wind speed 28 knots (32 mph or 51.5 kmph)	%	1.3	1.5	3.0	2.6	2.5	1.5	0.2	0.2	0.3	1.0	1.0	1.1	1.4	12
Percent frequency of surface wind speed 17 knots (20 mph or 32.2 kmph)	%	9.6	12.6	18.7	19.3	17.5	15.5	10.2	10.3	8.6	9.2	7.8	7.9	12.3	12
Mean number of days with surface wind speed >17 knots (20 mph or 32.2 kmph) and no precipitation	at 0400 LST	2.3	2.7	3.8	3.5	2.5	1.1	0.5	0.9	1.1	1.6	2.0	1.4	23.4	12
	at 1000 LST	2.4	2.5	5.1	5.0	3.5	2.1	0.6	0.8	1.3	1.7	2.0	2.7	29.7	12
	at 1600 LST	4.0	5.6	9.3	9.8	11.0	11.3	9.5	9.1	6.7	5.4	3.1	3.1	87.9	12
	at 2200 LST	3.1	4.5	6.3	5.5	5.1	5.0	3.9	3.5	2.6	2.6	2.1	2.5	46.7	12
Mean number of days with surface wind speed 4-10 knots (4.6-11.5 mph or 7.4-18.5 kmph) and temperature 33-89° F (0.6-31.7° C) and no precipitation	at 0400 LST	7.8	9.7	14.4	13.7	16.6	15.8	17.9	17.1	17.3	16.7	11.0	6.9	164.9	12
	at 1000 LST	8.1	7.1	10.0	9.4	14.0	9.3	4.5	5.4	7.4	8.6	7.8	6.1	97.7	12
	at 1600 LST	10.3	10.4	12.8	11.9	5.9	1.5	0.1	0.2	3.2	10.1	10.5	7.5	84.4	12
	at 2200 LST	14.7	14.7	14.7	14.5	15.2	11.3	10.6	11.3	15.7	18.2	17.8	16.6	175.3	12

H. CLIMATE (Continued)

PARAMETER	UNIT OF MEASURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	YEARS OF RECORD
Prevailing surface wind direction†		SSE	W	W	W	S	S	S	S	S	SSE	SSE	SSE	S	20
Mean wind speed†	knots	7	8	9	9	9	9	7	7	7	7	7	6	8	20
	mph	18.1	9.2	10.4	10.4	10.4	10.4	8.1	8.1	8.1	8.1	8.1	6.9	9.2	20
	kmph	13.0	14.8	16.7	16.7	16.7	16.7	13.0	13.0	13.0	13.0	13.0	11.0	14.8	20
Extreme wind speed†	knots	54	45	62	49	46	76	50	39	38	44	51	56	76	14
	mph	62.2	51.8	71.4	56.4	52.9	87.5	57.6	44.9	43.7	50.6	58.7	64.5	87.5	14
	kmph	100.0	83.3	114.8	90.8	85.2	140.8	92.6	72.2	70.4	81.5	94.5	103.7	141.8	14
Mean number of days with an occurrence of visibility 0.5 mile (0.8 km)		0.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	1.1	12
Percent frequency ceiling 5,000 ft (1,524 m) or visibility 5 miles (8 km)	%	3.4	2.7	2.0	1.6	0.3	0.0	0.1	0.0	0.2	0.7	1.1	1.7	1.2	12
Percent frequency ceiling < 1,500 ft (457.2 m) or visibility < 3 miles (4.83 km) for	0000-0200 LST	0.5	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.1	12
	0300-0500 LST	0.5	0.3	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.2	12
	0600-0800 LST	1.2	0.6	0.4	0.4	0.1	0.0	0.1	0.0	0.0	0.1	0.6	0.8	0.4	12
	0900-1100 LST	0.9	1.1	0.6	0.9	0.2	0.0	0.0	0.0	0.0	0.6	0.3	0.4	0.4	12
	1200-1400 LST	0.8	2.3	0.5	0.6	0.3	0.0	0.0	0.0	0.0	0.6	0.5	0.5	0.5	12
	1500-1700 LST	0.7	0.9	0.6	0.4	0.3	0.0	0.1	0.0	0.0	0.3	0.4	0.2	0.3	12
	1800-2000 LST	0.4	0.1	0.6	0.4	0.0	0.0	0.1	0.0	0.0	0.5	0.3	0.0	0.2	12
	2100-2300 LST	0.3	0.4	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	12
Percent frequency ceiling < 300 ft (91.4 m) or visibility < 1 mile (1.609 km) for	0000-0200 LST	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	12
	0300-0500 LST	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.1	12
	0600-0800 LST	0.8	0.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.4	0.2	12
	0900-1100 LST	0.4	0.1	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.4	0.2	0.1	0.2	12
	1200-1400 LST	0.3	0.2	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	12
	1500-1700 LST	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	12
	1800-2000 LST	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.0	0.1	12
	2100-2300 LST	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	12
Mean number of days with ceiling ≥1,000 ft (304.8 m) and visibility≥3 miles (4.83 km)	at 1900 LST	30.8	27.9	31.0	29.9	31.0	30.0	31.0	31.0	30.0	31.0	29.9	30.8	364.3	12
	at 0100 LST	30.7	27.8	30.7	29.6	30.9	30.0	31.0	31.0	30.0	30.8	30.0	30.9	363.4	12
	at 0700 LST	30.8	27.8	30.7	29.8	30.9	30.0	30.9	31.0	30.0	31.0	29.9	30.9	363.7	12
	at 1300 LST	30.9	27.9	31.0	29.8	31.0	30.0	31.0	31.0	30.0	31.0	29.9	30.8	364.3	12
Mean number of days with ceiling 2,000 ft (610 m), visibility 3 miles (4.83 km) and surface winds 10 knots (11.5 mph or 18.5 Kmph)	at 0400 LST	25.9	22.1	21.9	21.3	22.2	23.1	26.1	25.0	26.4	26.2	25.9	26.4	292.5	12
	at 1000 LST	26.0	23.3	23.1	21.5	23.3	24.2	27.3	26.9	27.5	27.7	26.8	26.9	304.5	12
	at 1600 LST	23.1	18.7	14.1	11.7	9.4	9.2	10.5	10.5	13.5	18.1	22.7	24.4	185.9	12
	at 2200 LST	22.4	17.2	13.9	13.1	13.5	10.7	12.8	10.7	13.7	19.5	22.5	25.0	196.0	12
Mean number of days with sky cover 30% and visibility 3 miles (4.83 km)	at 0400 LST	16.9	18.5	21.6	21.1	22.2	25.2	24.2	27.2	26.2	25.1	22.5	20.7	271.9	12
	at 1000 LST	12.1	12.7	16.0	16.8	19.7	24.9	23.7	24.6	24.1	20.8	17.5	15.0	227.9	12
	at 1600 LST	11.6	12.4	12.7	14.3	14.6	22.1	19.8	21.3	22.3	18.5	16.2	13.1	198.9	12
	at 2200 LST	15.8	17.7	19.8	20.1	22.2	26.8	25.3	27.2	27.2	24.7	21.2	19.7	267.7	12
Mean number of days with ceiling 2,500 ft (762 m) and visibility 3 miles (4.83 km)	at 0400 LST	30.8	27.9	30.9	29.9	31.0	30.0	31.0	31.0	30.0	31.0	29.9	30.8	364.2	12
	at 1000 LST	30.5	27.6	30.7	29.6	30.9	30.0	31.0	31.0	30.0	30.8	29.9	30.7	362.7	12
	at 1600 LST	30.4	27.7	30.5	29.7	30.9	30.0	30.9	31.0	30.0	31.0	39.8	30.8	362.7	12
	at 2200 LST	30.8	27.9	30.9	29.8	31.0	30.0	31.0	31.0	30.0	31.0	29.9	30.7	364.0	12
Mean number of days with ceiling 6,000 ft (1,829 m) and visibility 3 miles (4.83 km)	at 0400 LST	29.5	27.4	30.4	29.6	31.0	30.0	30.9	31.0	30.0	31.0	29.5	30.3	360.6	12
	at 1000 LST	29.1	27.4	30.2	29.3	30.7	30.0	31.0	30.9	29.9	30.6	29.5	30.4	359.0	12
	at 1600 LST	29.5	26.7	29.5	38.7	30.8	29.9	30.7	31.0	30.0	30.7	29.3	30.5	357.3	12
	at 2200 LST	29.6	27.7	30.7	29.3	31.0	30.0	31.0	31.0	29.9	30.8	29.5	29.8	360.3	12
Mean number of days with ceiling 10,000 ft (3,048 m) and visibility 3 miles (4.83 km)	at 0400 LST	28.6	26.6	30.2	29.2	30.7	29.9	30.6	30.8	29.6	30.8	29.0	29.7	355.7	12
	at 1000 LST	28.1	26.5	29.4	28.3	30.3	30.0	30.7	30.7	29.5	29.9	28.9	29.2	351.5	
	at 1600 LST	28.0	25.5	28.9	27.3	29.1	29.5	28.5	29.9	29.5	29.6	28.0	29.6	343.4	12
	at 2200 LST	28.8	26.4	30.0	28.6	30.5	29.9	30.7	30.8	29.8	30.3	29.2	29.3	354.3	12

* Except where otherwise indicated, climatic values are derived from the Inyokern/China Lake NAF (Latitude 35° 41′ N, Longitude 117° 41′ W; elevation 696 m or 2283 ft), approximately 106 km or 66 miles WNW of Fort Irwin.

† These climatic data are derived from George AFB (Latitude 34° 35′ N, Longitude 117° 32′ W; elevation 876 m or 2875 ft), located approximately 113 km or 70 miles SW of Fort Irwin.

‡ Mean pressure altitude figures are from Bicycle Lake AAF (Latitude 35° 17′ N, Longitude 116° 37′ W, elevation 716 m or 2350 ft), located approximately 6 km or 4 miles E of Fort Irwin.

EPHEMERIS FOR FORT IRWIN, CALIFORNIA

(PACIFIC STANDARD TIME)

DATE	NAUTICAL TWILIGHT BEGIN	NAUTICAL TWILIGHT END	SUNRISE	SUNSET
January 1	0555	1745	0655	1645
January 11	0552	1753	0656	1654
January 21	0554	1802	0653	1703
February 1	0549	1812	0646	1715
February 11	0541	1821	0637	1725
February 21	0531	1830	0626	1734
March 1	0522	1837	0617	1742
March 11	0508	1845	0603	1751
March 21	0454	1854	0549	1759
April 1	0438	1903	0534	1808
April 11	0423	1913	0520	1816
April 21	0409	1922	0507	1824
May 1	0356	1932	0455	1832
May 11	0344	1942	0446	1840
May 21	0335	1952	0438	1848
June 1	0328	2001	0433	1856
June 11	0325	2008	0431	1901
June 21	0325	2011	0432	1904
July 1	0329	2012	0435	1905
July 11	0335	2008	0440	1903
July 21	0343	2002	0447	1858
August 1	0353	1952	0455	1850
August 11	0403	1940	0503	1840
August 21	0412	1926	0510	1828
September 1	0422	1910	0519	1814
September 11	0430	1855	0526	1800
September 21	0438	1840	0533	1745
October 1	0446	1825	0541	1731
October 11	0454	1812	0549	1717
October 21	0502	1800	0558	1704
November 1	0511	1748	0608	1652
November 11	0520	1741	0617	1643
November 21	0529	1736	0627	1637
December 1	0537	1733	0637	1634
December 11	0545	1734	0645	1634
December 21	0551	1738	0651	1638

I. CROSS-COUNTRY MOVEMENT

This map deals with cross-country movement, or movement away from roads, and is primarily intended for use in planning operations. For determining exact driving routes, reconnaissance on the ground is required. Data on the terrain factors and the evaluations are generalized to suit the scale of the map. Many areas of minor extent, such as minor depressions, boulder fields and sandy areas, are too small to portray.

The predicted movement ratings are those believed to prevail in most years. Variations in these evaluations may occur from year to year and even within a season due to abnormal variations in the weather. Rainy weather will cause movement to be slower in all the map units. In the playas (drainage basins), movement may become impossible during the wet period.*

The evaluations are based on terrain conditons as they are known at present. Future alterations of the terrain, such as construction of roads or artificial drainage, would obviously change cross-country movement conditions.

MAP UNIT	GENERAL TERRAIN	MOVEMENT OF TRACKED VEHICLES +	MOVEMENT OF WHEELED VEHICLES ++	MOVEMENT OF FOOT TROOPS
1. Smooth, sandy or gravelly plains.	Generally smooth, sandy and gravelly plains; most slopes less than 10 percent. Soils generally firm, but locally, small areas covered with loose sand. Widely separated washes or arroyos (entrenched dry stream beds) on steeper slopes. Vegetation extremely sparse consisting of scattered low bushes and some grasses and forbs. Arroyos carry water only for a few hours after infrequent rains.	Movement unrestricted in all directions. Tracked vehicle movement creates dust signatures visible from great distances, up to 25 km (16 mi). Movement in trace during wet weather not recommended.	Movement generally easy in all directions. Locally, loose sand may slow movement. With careful selection of sites, arroyos can be crossed even where deeply entrenched. Vegetation not a factor in movement.	Movement easy in all directions. Concealment not available.
2. Level, barren drainage basins (playas).*	Level, barren lake beds (playas) in drainage basins scattered throughout reservation. Soils highly alkaline and clayey. Lake beds are firm throughout the year but may become extremely soft and miry following unusually heavy rains when basins may be flooded. Rains are most likely to occur between November and March.	Movement unrestricted in all directions except when soils soft and miry. Vehicle movement creates dust signatures visible from great distances, up to 25 km (16 mi).	Movement unrestricted in all directions except when soils soft and miry. Vehicle movement creates dust signatures visible from great distances, up to 25 km (16 mi).	Movement easy except when lake beds flooded.
3. Moderately sloping terrain dissected by arroyos (entrenched dry stream beds).	Dissected terrain abutting hills and mountains. Most slopes range from 10 to 30 percent. Soils gravelly with some areas of rock outcrops. Slopes dissected by numerous drainage channels (washes and arroyos) which are mostly shallow with a few deeply entrenched. Sparse vegetation not a factor in movement.	Movement moderately hindered by numerous drainage channels, especially when moving parallel to contours. Areas of rock-covered slopes can be bypassed. Maneuverability restricted by washes and arroyos. APC can use deeper arroyos as hull defilade sites; tanks afforded less concealment.	Heavy wheeled vehicles severely hampered by slopes, drainage channels, and rock-covered slopes. Small vehicles can move easily in many arroyo bottoms.	Movement moderately slowed by steep slopes. Arroyos afford concealment in mountain approaches.
4. Moderately dissected terrain with steep slopes.	Moderately dissected terrain with slopes ranging from 30 to 45 percent. Area mostly rock outcrops with very thin, loose, sandy gravel soil cover. Arroyos add to the roughness of the area already charcterized by jagged, rocky outcrops. Vegetation sparse.	Movement possible in most places but severely hampered by roughness of terrain. Maneuverability impossible.	Movement impractical due to rocky terrain. Steep slopes are beyond the capabilities of the vehicles. Vehicles may be damaged by rocky outcrops.	Movement slow among rock outcrops and in places, possible in column formation only. Footing hampered by loose rocks. Cover and concealment abundant.
5. Steep hills and mountains with many rocky escarpments.	Very steep, rough, rocky hills and mountains covered with very thin, sandy, gravel soil. Slopes greater than 45 percent. These extremely rough surfaces lack vegetation.	Movement is impractical because of steep slopes and roughness of terrain. Vehicle damage likely because of rocky outcrops.	Movement is impractical because of steep slopes and roughness of terrain.	Feasible but very slow and difficult due to steep slopes and rocky outcrops. Movement in column formation required in most places. Footing hampered by loose rocks. Cover and concelment abundant.

+Comments apply to the M-60 tank and the M-113 armored personnel carrier.
++Comments apply to the M-35 2½-ton truck and the M-151 ¼-ton truck.

*Movement conditions in the playas will be degraded for periods of days to weeks during the wet season. Playa surfaces will occasionally be covered by a dry crust with wet, miry conditions underneath. Ground reconnaissance would be necessary before moving through those areas.

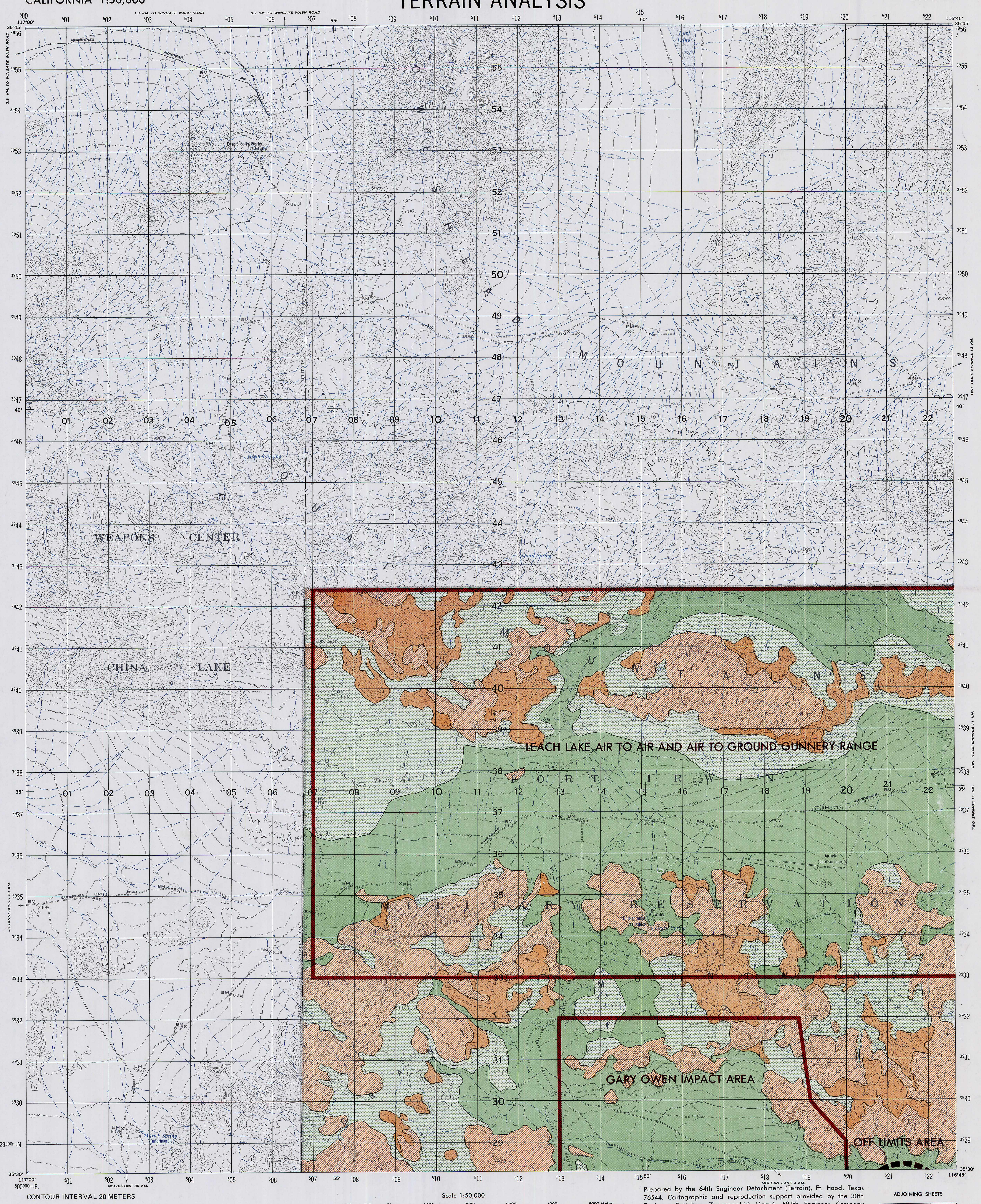
EXPLANATION OF WET AND DRY PERIODS

DRY PERIOD	From April through October the rainfall rate has been 0.2 cm (0.08 in) per month for the past 12 years. This period allows for thorough drying of the silty playas.
WET PERIOD	From November through March, an average of 1.3 cm (0.5 in) per month of rainfall has fallen during the last 12 years. Maximum was 7.1 cm (2.8 in) in one month. Unusual variations of the weather may alter this period.

CALIFORNIA 1:50,000

FORT IRWIN, CALIFORNIA TERRAIN ANALYSIS

SHEET 2655 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2555 I	2655 IV	2655 I
2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

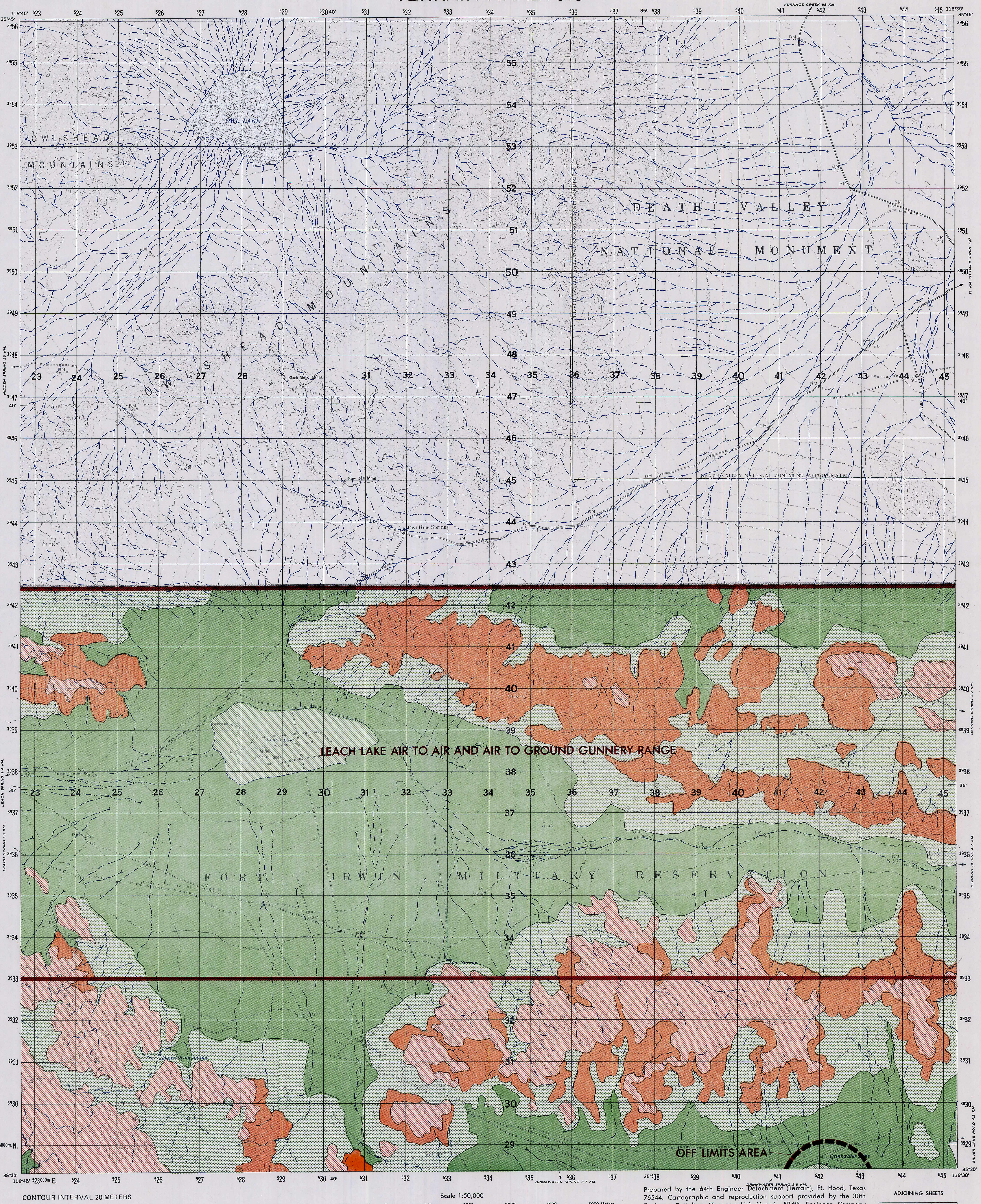
Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2655 IV	2655 I	2755 IV
2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

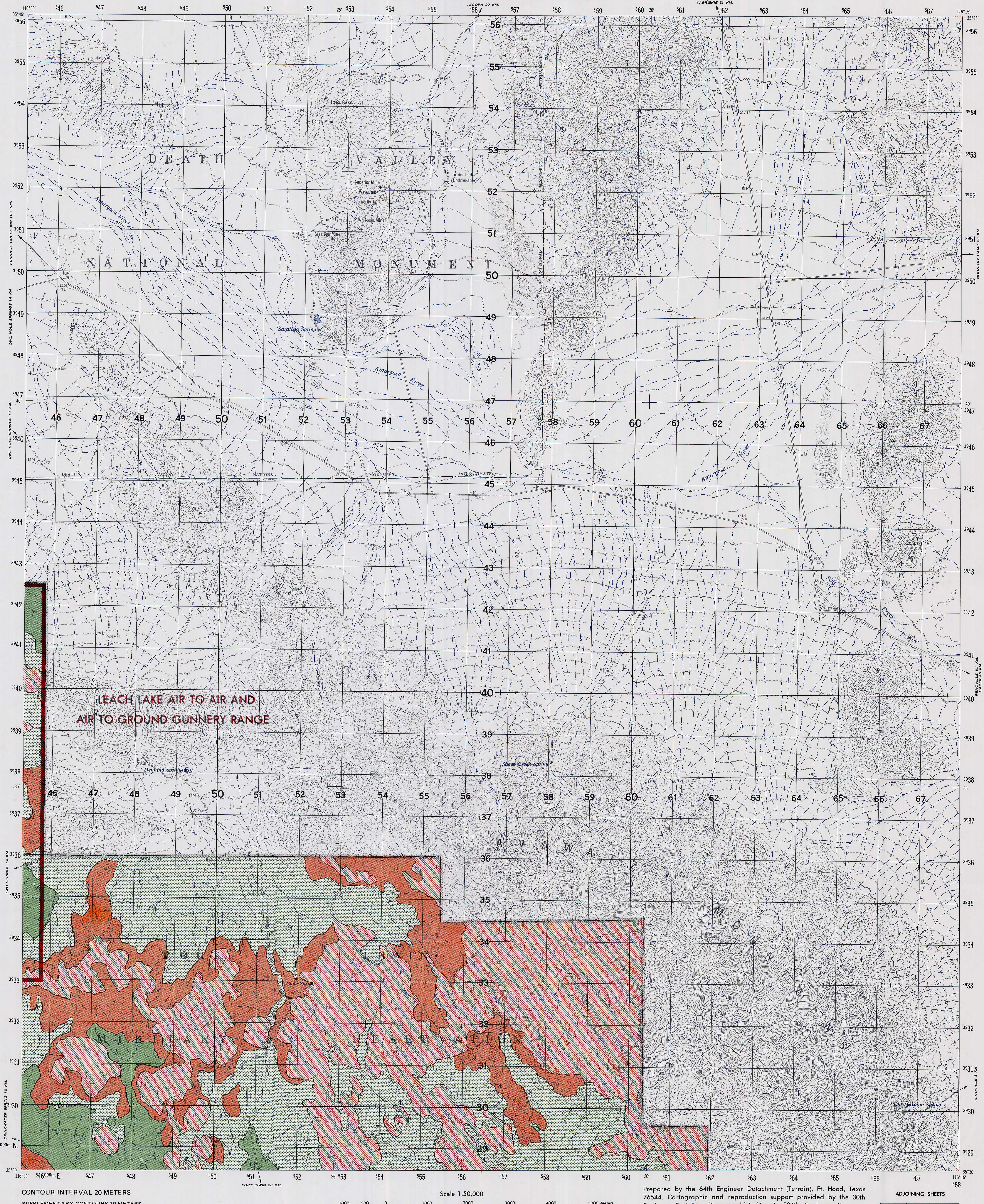
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2.	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

CALIFORNIA 1:50,000

FORT IRWIN, CALIFORNIA TERRAIN ANALYSIS

SHEET 2755 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2655 I	2755 IV	2755 I
2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

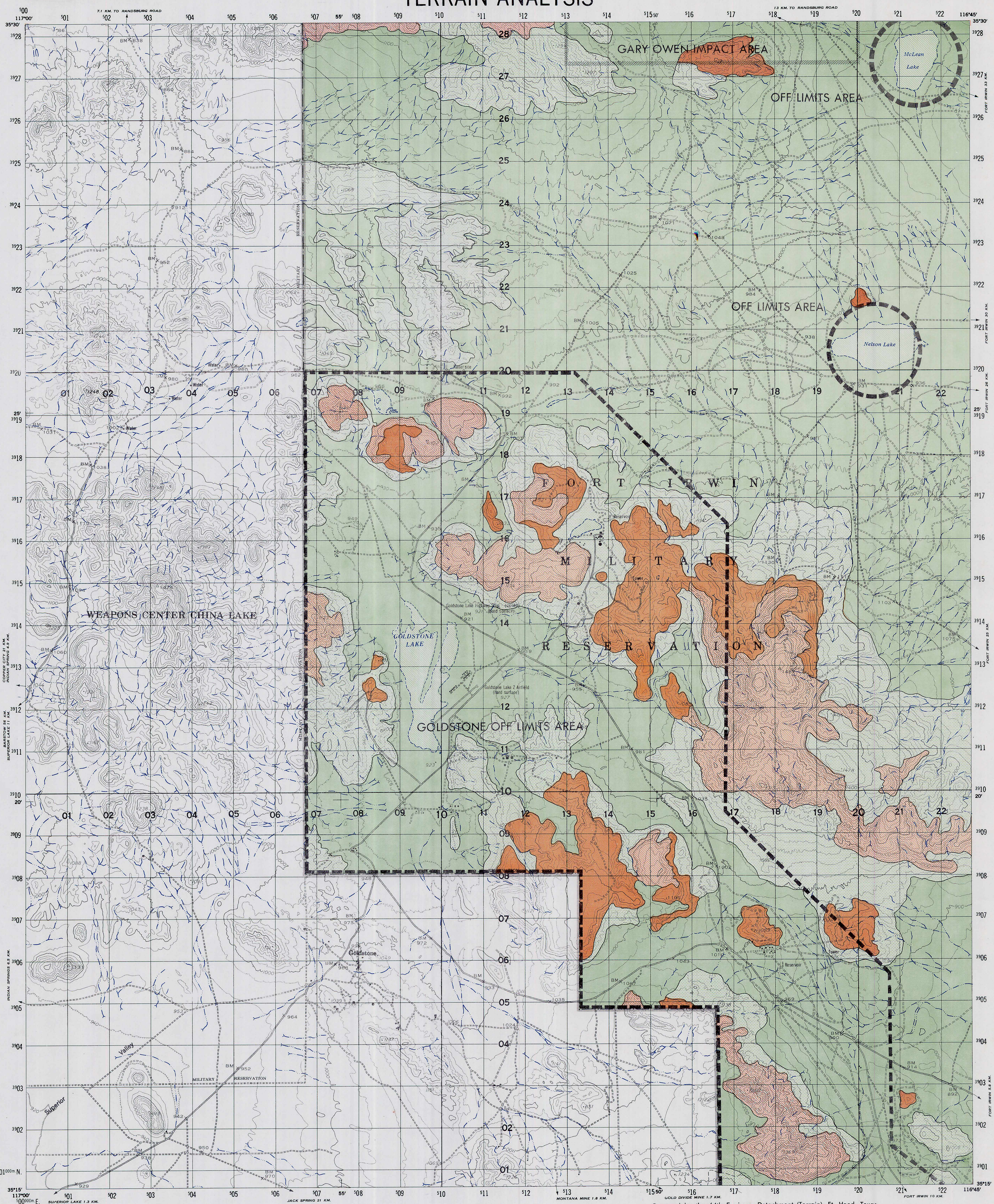
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

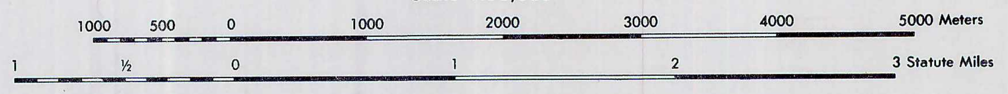
SHEET 2654 IV



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000



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ADJOINING SHEETS

2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

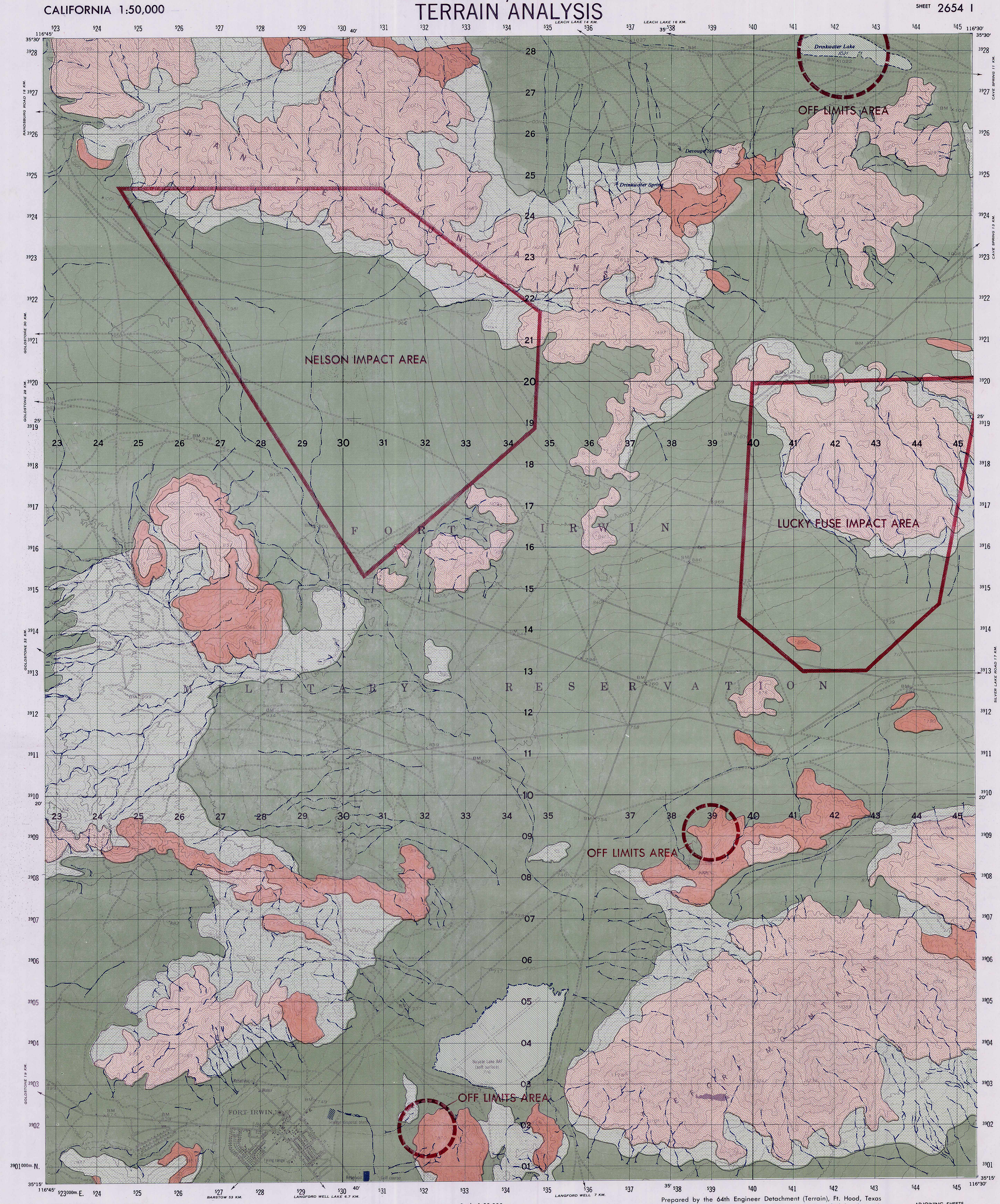
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 I



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

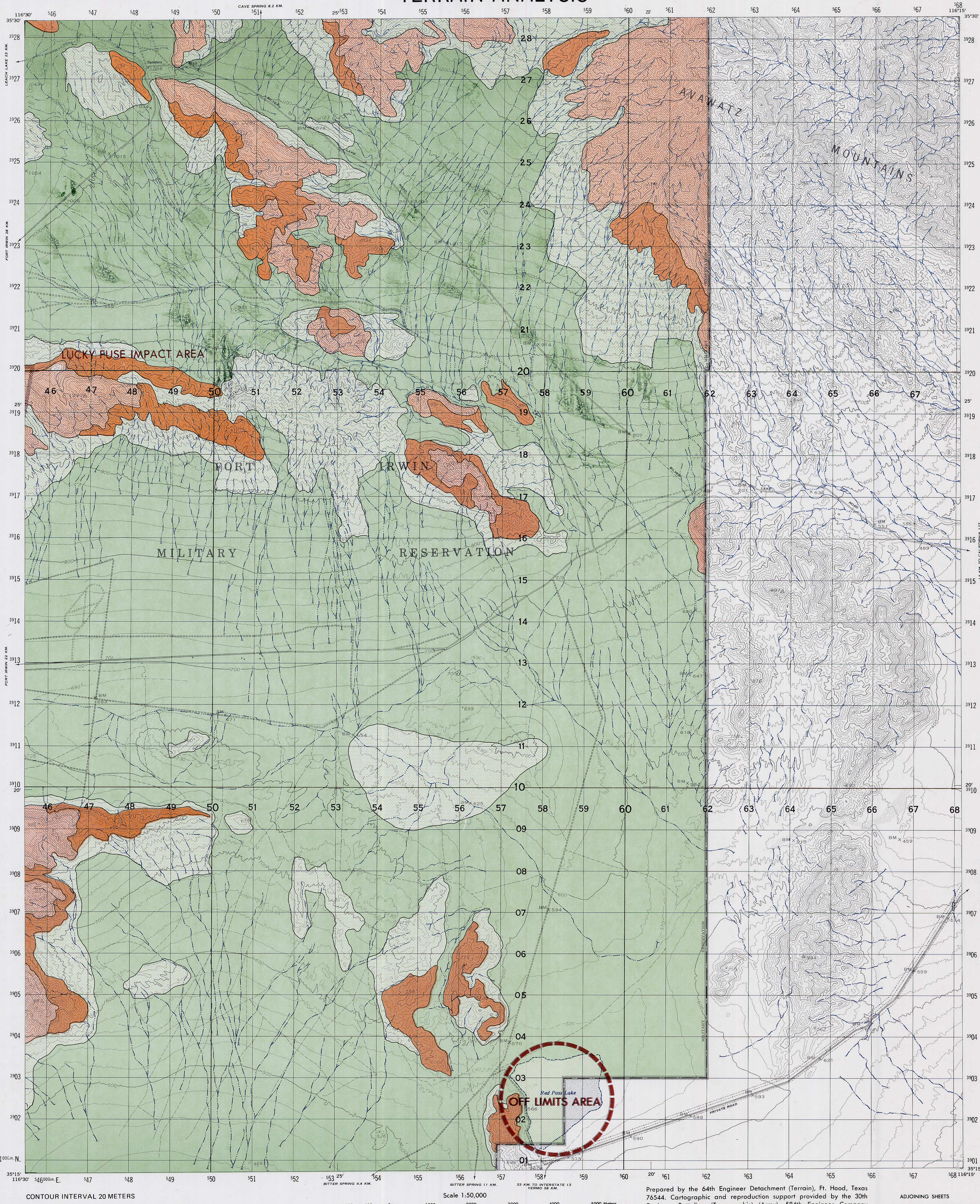
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 IV



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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ADJOINING SHEETS

2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II

EXPLANATION OF RATING TERMS

Good Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

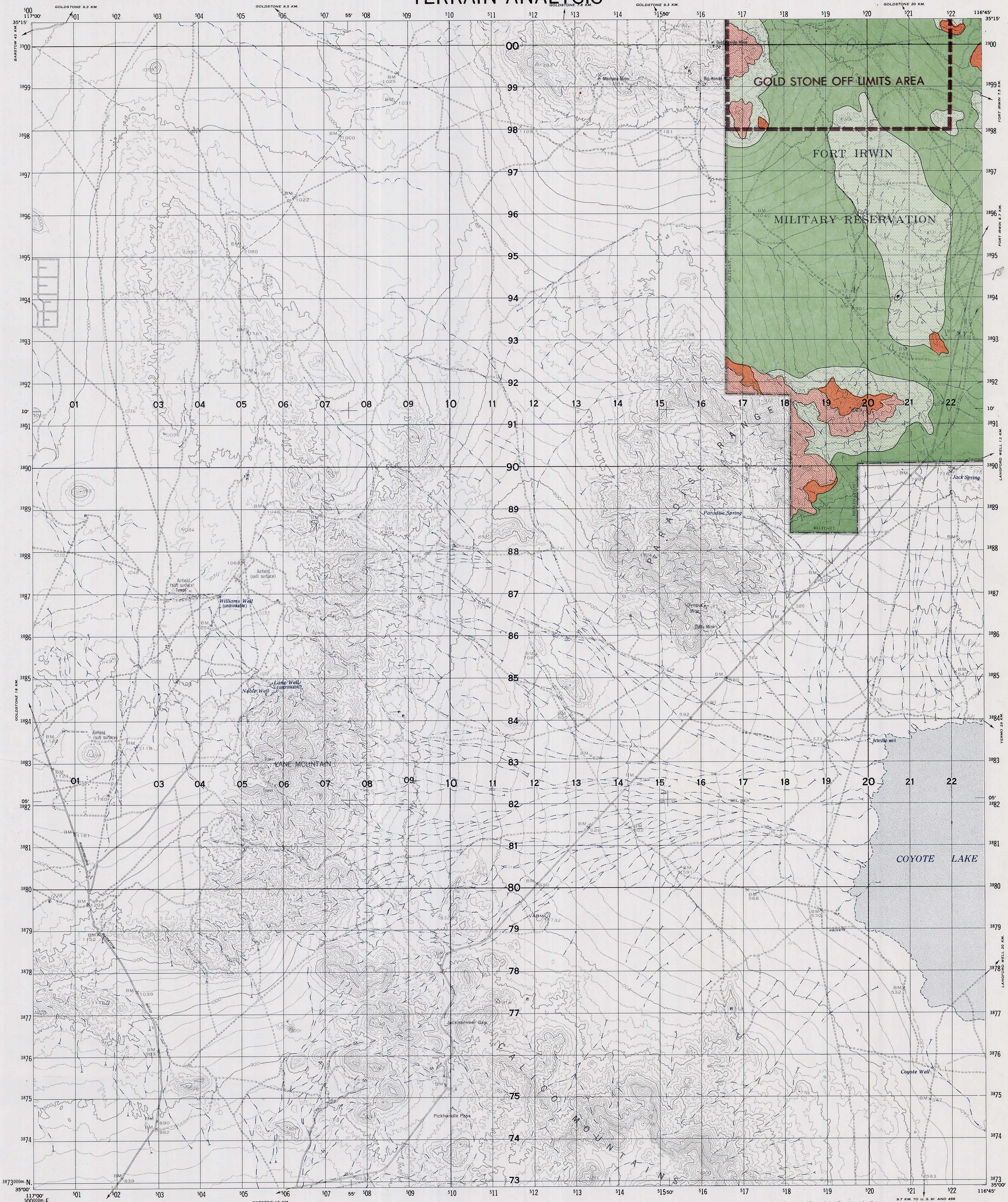
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

CALIFORNIA 1:50,000

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

SHEET 2654 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II
2553 I	2653 IV	2653 I

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

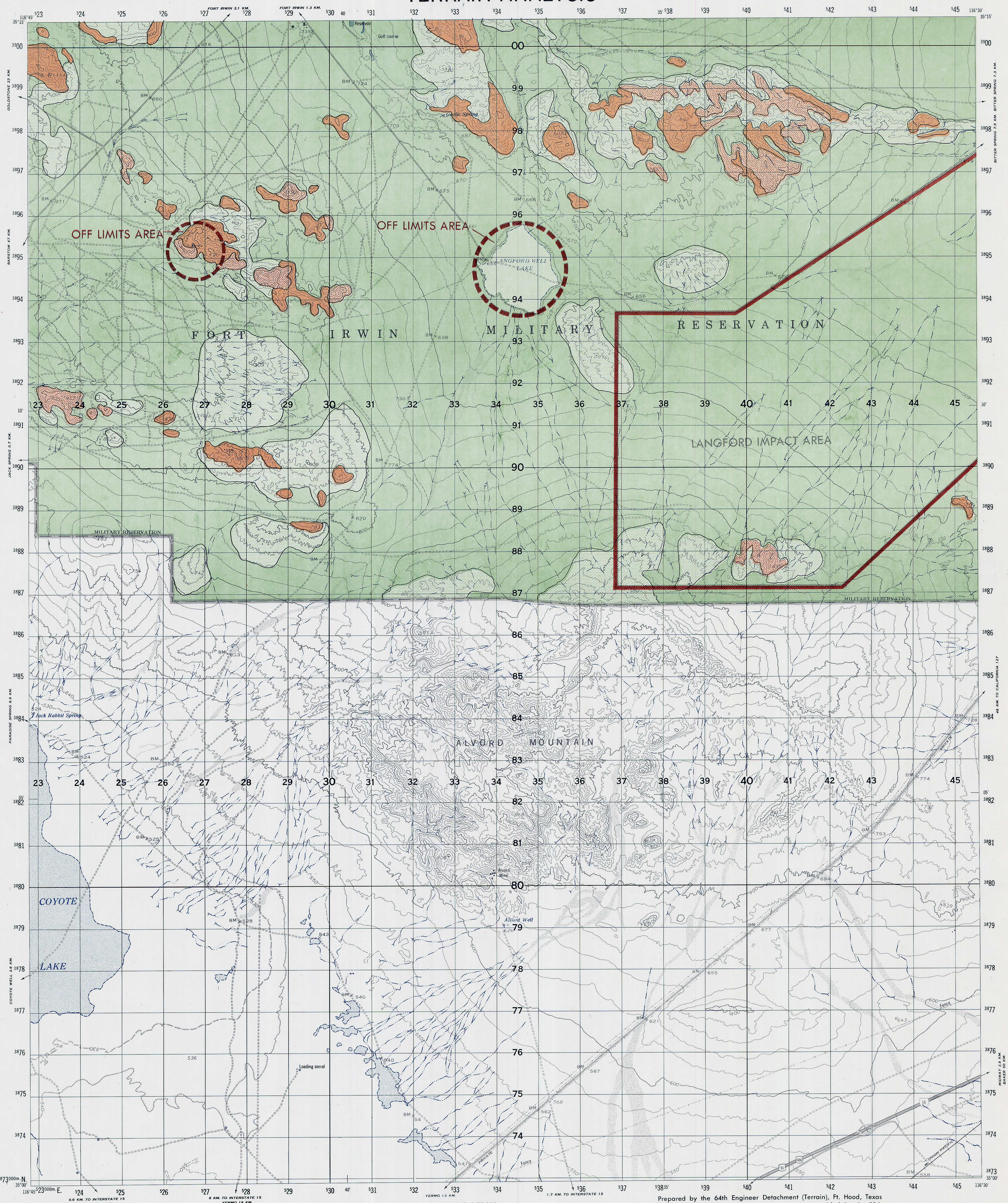
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 II



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2654 IV	2654 I	2734 IV
2654 III	2654 II	2734 III
2653 IV	2653 I	2753 IV

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

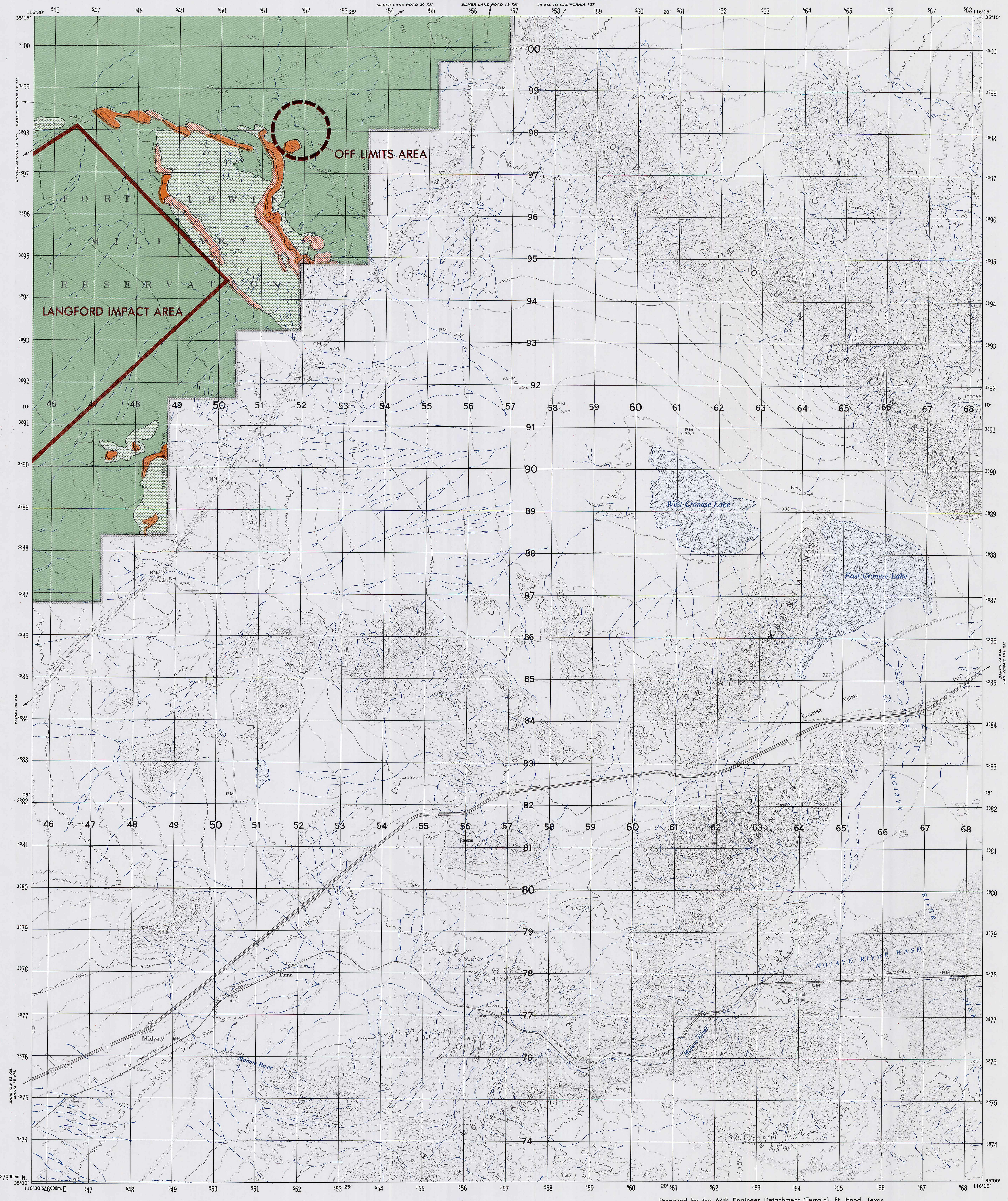
MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

CALIFORNIA 1:50,000

FORT IRWIN,CALIFORNIA
TERRAIN ANALYSIS

SHEET 2754 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II
2653 I	2753 IV	2753 I

EXPLANATION OF RATING TERMS

Good — Conditions permit free movement in any direction. Terrain will permit 12 or more passes in trace of an M-60 tank or permit at least one maneuver (starts, stops, sharp turns, or crossing of tracks) at one location.

Fair — Conditions moderately hinder progress or moderately restrict choices of direction for movement. Terrain will permit 3 to 12 passes in trace of an M-60 but maneuvering will be difficult.

Poor — Conditions severly hinder progress or greatly restrict choice of movement routes. Terrain will probably permit up to 3 passes in trace of an M-60. Vary cautious driving required. Movement in trace should be avoided.

Unsuited — Conditions prelude all but local movement. Engineer work required for vehicular movement.

Impact area; off-limits to vehicles and foot troops due to danger of unexploded munitions.

CROSS—COUNTRY MOVEMENT

MAP UNIT	TERRAIN UNIT	PREDICTED MOVEMENT RATINGS FOR: TANK (M-60)	APC (M-113)	2½-TON TRUCK (M-35)	¼-TON TRUCK (M-151)	FOOT TROOPS
1	Smooth sandy or gravelly plains, slopes 0 to 8 percent.	Good	Good	Good	Good	Good
2	Level, barren drainage basins (playas).	Good	Good	Good	Good	Good
3	Moderately sloping terrain dissected by arroyos; slopes 10 to 45 percent.	Fair	Fair	Poor	Poor	Fair
4	Moderately dissected terrain; slopes 30 to 45 percent.	Poor	Poor	Unsuited	Unsuited	Fair
5	Steep hills and mountains; slopes greater than 45 percent.	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited

Note: Number refers to entry in table.

J. LINES OF COMMUNICATION

1. ROADS

Fort Irwin's road network radiates outward from the cantonment area, which is situated near the center of the reservation. The roads vary from hard-surfaced primary roads to tank trails. There are 382 km (237 mi) of roads and tank trails on the reservation. There are over 800 km (496 mi) of other trails of varying quality (not shown on the map) located throughout the reservation.

The surface condition of many roads has deteriorated since the deactivation * of the installation, particularly the housing area streets. The paved roads located in the Goldstone Deep Space Communications Complex (GDSCC) are generally well maintained by private enterprise. Improved and unimproved dirt roads exist in the reservation; the principal difference is the frequency of use, the former being travelled much more than the latter.

Tank trails exist generally parallel to some of the principal roads and are sufficiently wide to permit two tanks to easily pass.

Many of the reservation roads are subject to flash flooding. The cantonment area streets are protected by a drainage channel on the northwest side.

There are no bridges on Fort Irwin. Goldstone Road and Barstow Road cross the drainage channel on reinforced concrete box culverts.

* Lines of Communiction were compiled and partially field checked in 1978.

						SURFACE		SHOULDERS	
ROUTE NAME	GRID REFERENCE FROM	TO	LENGTH OF SEGMENT	MILITARY LOAD CLASSIFICATION	ROUTE TYPE	CONSTRUCTION MATERIALS	WIDTH/ CONDITION	CONSTRUCTION MATERIALS	WIDTH/ CONSTRUCTION
1st Street									
Segment 1	NK28200215	NK28550182	0.52 km (0.32 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Segment 2	NK28760165	NK29150113	0.66 km (0.41 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
2nd Street									
Segment 1	NK28300225	NK28450210	0.21 km (0.13 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Segment 2	NK28900173	NK29300122	0.66 km (0.41 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
3rd Street	NK28400233	NK29350330	1.43 km (0.89 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
4th Street									
Segment 1	NK28450240	NK28650218	0.33 km (0.21 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Segment 2	NK28890215	NK28970204	0.12 km (0.07 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Segment 3	NK29060187	NK29270165	0.43 km (0.27 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
5th Street									
Segment 1	NK28620260	NK28980222	1.01 km (0.63 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Segment 2	NK28950220	NK29350167	0.49 km (0.30 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Avenue A	NK28620260	NK27960191	1.03 km (0.64 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Avenue B	NK28750245	NK28250190	0.80 km (0.50 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Avenue C	NK28850235	NK28400190	0.71 km (0.44 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Avenue D	NK28930209	NK28730190	0.32 km (0.20 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Avenue E	NK28960204	NK28750185	0.32 km (0.20 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Avenue F	NK29130196	NK28670158	0.59 km (0.37 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Avenue G	NK29350169	NK28900134	0.94 km (0.59 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Avenue H	NK29550142	NK29100105	0.73 km (0.45 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Antietam Street	NK27830125	NK27870110	0.21 km (0.13 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/good	No data	No data
Anzio Street	NK27800104	NK27950160	0.43 km (0.27 mi)	No data)	All weather	Asphalt	7.3 m (24 ft)/good	No data	No data
Avawatz Trail	NK50803600	NK49302725	10.8 km (6.7 mi)	No data	Fair weather	Dirt	3.05 m (10 ft)/poor	No shoulders	No shoulders
Barstow Road	NJ21349010	NK49302725	50.7 km (31.5 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/excellent	Dirt	3.05 m (10 ft)/good
Bastogne Street	NK27600076	NK28000129	0.52 km (0.32 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Bataan Loop	NK27400117	NK27480125	0.21 km (0.13 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/fair	No data	No data
Bicycle Lake Road	NK30760408	NK33250288	2.63 km (1.63 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Bull Run Street	NK27840172	NK28060185	0.40 km (0.25 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Covington Road	NK10341184	NK11841085	1.97 km (1.22 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/excellent	Dirt	No data
East Range Road	NK36951168	NK61801704	27.4 km (17.0 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	Dirt	No data
Echo Road	NK17020615	NK18000620	1.05 km (0.65 mi)	No data	All weather	Asphalt	7.6 m (25 ft)/good	Dirt	2.4 m (8 ft)/good
Goddard Road	NK09100982	NK11851335	4.9 km (3.0 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/excellent	Dirt	No data
Goldstone Road									
Segment 1	NK11551855	NK19860406	22.7 km (14.1 mi)	No data	All weather	Asphalt	6.9 m (22.5 ft)/excellent	Dirt	3.05 m (10 ft)/good
Segment 2	NK19860406	NK28380189	9.5 km (5.9 mi)	No data	All weather	Asphalt	5.5 m (18 ft)/good	Dirt	1.86 m (6 ft)/fair
Hoff Road	NK07621185	NK09090982	3.29 km (2.04 mi)	No data	All weather	Asphalt	3.05 m (10 ft)/poor	No shoulders	No shoulders
Langford Lake Road									
Segment 1	NK28150207	NK29700026	3.0 km (1.9 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
Segment 2	NK29700026	NJ33709492	6.8 km (4.2 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Mars Road	NK10152002	NK11551855	2.04 km (1.27 mi)	No data	All weather	Asphalt	6.9 m (22.5 ft)/excellent	Dirt	No data
Mengel Road	NK09100982	NK10530956	1.25 km (0.78 mi)	No data	All weather	Asphalt	5.2 m (17 ft)/fair	Dirt	0.9 m (3 ft)/poor
Meuse-Argonne Street									
Segment 1	NK27050175	NK27300175	0.24 km (0.15 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Segment 2	NK27600162	NK27910165	0.31 km (0.19 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Monterey Street	NK27540128	NK27700120	0.15 km (0.10 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/good	No data	No data
NASA Road									
Segment 1	NK19860406	NJ21409982	4.6 km (2.8 mi)	No data	All weather	Asphalt	7.2 m (23.5 ft)/excellent	Dirt	3.05 m (10 ft)/good
Segment 2	NJ21409982	NJ24569762	4.2 km (2.6 mi)	No data	All weather	Asphalt	7.2 m (23.5 ft)/excellent	Dirt	3.05 m (10 ft)/good
Normandy Drive	NK27330110	NK28070187	0.98 km (0.61 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/good	No data	No data
North Echo Tower Road	NK18000620	NK19320700	2.37 km (1.47 mi)	No data	Fair weather	Dirt	3.05 m (10 ft)/poor	No shoulders	No shoulders
Old Goldstone Road	NK13260504	NK16910622	4.1 km (2.5 mi)	No data	Fair weather	Dirt	4.4 m (14.5 ft)/good	No shoulders	No shoulders
Omaha Beach Street	NK27300194	NK27400140	0.52 km (0.32 mi)	No data	All weather	Asphalt	5.5 m (18 ft)/fair	No data	No data
Pioneer Road	NK12271302	NK13881615	3.9 km (2.5 mi)	No data	All weather	Asphalt	7.0 m (23 ft)/excellent	Dirt	1.2 m (4 ft)/fair
Pioneer Tower Road									
Segment 1	NK13581510	NK14541431	1.4 km (0.87 mi)	No data	All weather	Asphalt	3.7 m (12 ft)/fair	No shoulders	No shoulders
Segment 2	NK14541431	NK14881493	0.57 km (0.35 mi)	No data	Fair weather	Dirt	3.05 m (10 ft)/poor	No shoulders	No shoulders
Pork Chop Hill Street	NK27600190	NK27670145	0.46 km (0.28 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/fair	No data	No data
Randsburg Road	NK06903515	NK30664246	27.5 km (17.1 mi)	No data	Fair weather	Dirt	3.4 m (11 ft)/fair	No shoulders	No shoulders
Rhineland Drive	NK27050196	NK27640084	1.25 km (0.78 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Salerno Drive	NK27700165	NK28020125	0.55 km (0.34 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/good	No data	No data
Shiloh Street	NK27890135	NK28010125	0.21 km (0.13 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/good	No data	No data
Silver Lake Road	NK49302725	NK61751705	17.1 km (10.6 mi)	No data	Fair weather	Dirt	5.5 m (18 ft)/fair	No data	No data
Spacecraft Road	NK16700686	NK16820699	0.16 km (0.1 mi)	No data	All weather	Asphalt	4.3 m (14 ft)/fair	Dirt	2.3 m (7.5 ft)/poor
Stone Tower Road	NK11841085	NK13600882	3.2 km (2.0 mi)	No data	Fair weather	Asphalt	3.05 m (10 ft)/good	No shoulders	No shoulders
St. Lo Street	NK27810168	NK27840160	0.90 km (0.06 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
St. Mihiel Street	NK27500130	NK27750005	0.33 km (0.21 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/fair	No data	No data
Tippecanoe Street	NK27210170	NK27350135	0.39 km (0.24 mi)	No data	All weather	Asphalt	5.5 m (18 ft)/fair	No data	No data
Tunisia Street	NK27200123	NK27400140	0.21 km (0.13 mi)	No data	All weather	Asphalt	5.5 m (18 ft)/fair	No data	No data
Utah Beach Street	NK27250142	NK27340148	0.09 km (0.06 mi)	No data	All weather	Asphalt	5.5 m (18 ft)/fair	No data	No data
Venus Road	NK18440031	NK20390147	2.1 km (1.3 mi)	No data	All weather	Asphalt	7.5 m (24.5 ft)/good	Dirt	3.5 m (11.5 ft)/good
West Cut-off Road	NK32051110	NK36130945	4.6 km (2.9 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
West Range Road	NK30271087	NK36951168	6.8 km (4.2 mi)	No data	All weather	Asphalt	6.7 m (22 ft)/fair	No data	No data
Wilderness Street	NK27130173	NK27270130	0.52 km (0.32 mi)	No data	All weather	Asphalt	5.5 m (18 ft)/fair	No data	No data
Yorktown Street	NK27430115	NK27670010	0.33 km (0.21 mi)	No data	All weather	Asphalt	7.3 m (24 ft)/fair	No data	No data
Improved Dirt Roads			37 km (23 mi)						
Unimproved Dirt Roads			52 km (32 miles)						
Tank Trails			43 km (27 mi)						

2. RAILROADS

There are no railroads on the reservation; however, prior to deactivation a railroad was proposed from the cantonment area to the Union Pacific line at Manic, CA.

3. AIRFIELDS/AIRSTRIPS

MAP NUMBER AND NAME; LOCATION; TYPE; AND CLASSIFICATION	ELEVATION AND STATUS	RUNWAY DESCRIPTION	TAXIWAY, PARKING, APRON, AND HARDSTAND AREA DESCRIPTION	BUILDING DESCRIPTION	POL FACILITIES	NAVIGATONAL AIDS
1. Goldstone Lake Airstrip; NK105122; landing strip; private.	926.6 m (3040 ft); operational, off-limits to military.	1371.6 m X 18.3 m (4550 ft X 60 ft); azimuth, 052° - 232°; maximum weight bearing capacity unknown; asphaltic concrete surface.	Hardstand/Turnaround: 48.8 m (160 ft) diameter circle at north end with six tie-down anchors; maximum weight bearing capacity unknown; asphaltic concrete surface. Turnaround: 22.9 m (75 ft) diameter circle at south end; maximum weight bearing capacity unknown; asphaltic concrete surface.	No buildings.	None.	None.
2. Goldstone Lake Airstrip; NK101144; landing strip; private.	921.1 m (3022 ft); abandoned (emergency use only), off-limits to military.	1615.4 m X 15.2 m (5300 ft X 50 ft); azimuth, 126° - 306°; maximum weight bearing capacity unknown; asphaltic concrete surface.	None.	No buildings.	None.	
3. Goldstone Lake Airstrip; NK100130; landing strip; private.	919.9 m (3018 ft); abandoned (emergency use only), off-limits to miltary.	1828.8 m X 30.5 m (6000 ft X 100 ft); azimuth, 012° - 192°; maximum weight bearing capacity ST-124; dirt surface.	Apron: 70.1 m (230 ft) X 76.2 m (250 ft) at north end; maximum weight bearing capacity unknown; asphaltic concrete surface.	One terminal building: Permanent building, GDSCC number G-71, concrete floor with block walls and concrete and metal roof, 33.4 m^2 (360 ft^2). One storage building: Permanent building, GDSCC number G-70, concrete floor with block walls and framed metal roof, 26.8 m^2 (288 ft^2).	1 small aviation gasoline storage tank; capacity unknown.	Lights: Runway lights inoperative.
4. Bicycle Lake Army Airfield; NK336041; military airfield; Army.	716.3 m (2350 ft); operational, off-limits to military.	Primary runway: **2895.6 m X 61.0 m (9500 ft X 200 ft); azimuth, 051° - 231°; maximum weight bearing capacity ST-124; dirt surface.** Crosswind runway: **1767.8 m X 48.8 m (5800 ft X 160 ft); azimuth, 140° - 320°; maximum weight bearing capacity ST-124; dirt surface.**	Taxiway: 781.1 m X 21.9 m (2520 ft X 75 ft); maximum weight bearing capacity ST-124; dirt surface. Apron: 161.5 m X 73.1 m (530 ft X 240 ft); maximum weight bearing capacity unknown; asphaltic concrete surface. Compass swing base: 351.2 m^2 (3780 ft^2); maximum weight bearing capacity unknown; asphaltic concrete surface.	One hangar: Temporary building, number T-6203, concrete floor with steel pre-fab metal siding and and roof, 752.5 m^2 (8100 ft^2). One operations building: Temporary building, number T-6201, concrete floor with wood frame and composition shingle roof, 320.5 m^2 (3450 ft^2).	2 underground tanks totalling 113, 560 liters (30,000 gal), 4 pumps, 1 tank 3785 liters (1000 gal), liquid petroleum gas (LPG).	One control tower: Temporary building, number T-6202, steel frame, 18.2 m^2 (196 ft^2); temporary ground control approach system.

4. PIPELINES

There are no pipelines on the reservation; however, prior to deactivation, a natural gas pipeline to service the installation was planned from Barstow to the cantonment area.

5. HELICOPTER LANDING ZONES

No permanent helicopter landing zones are designated; presently, helicopters may land virtually anywhere on the reservation and in the cantonment area.

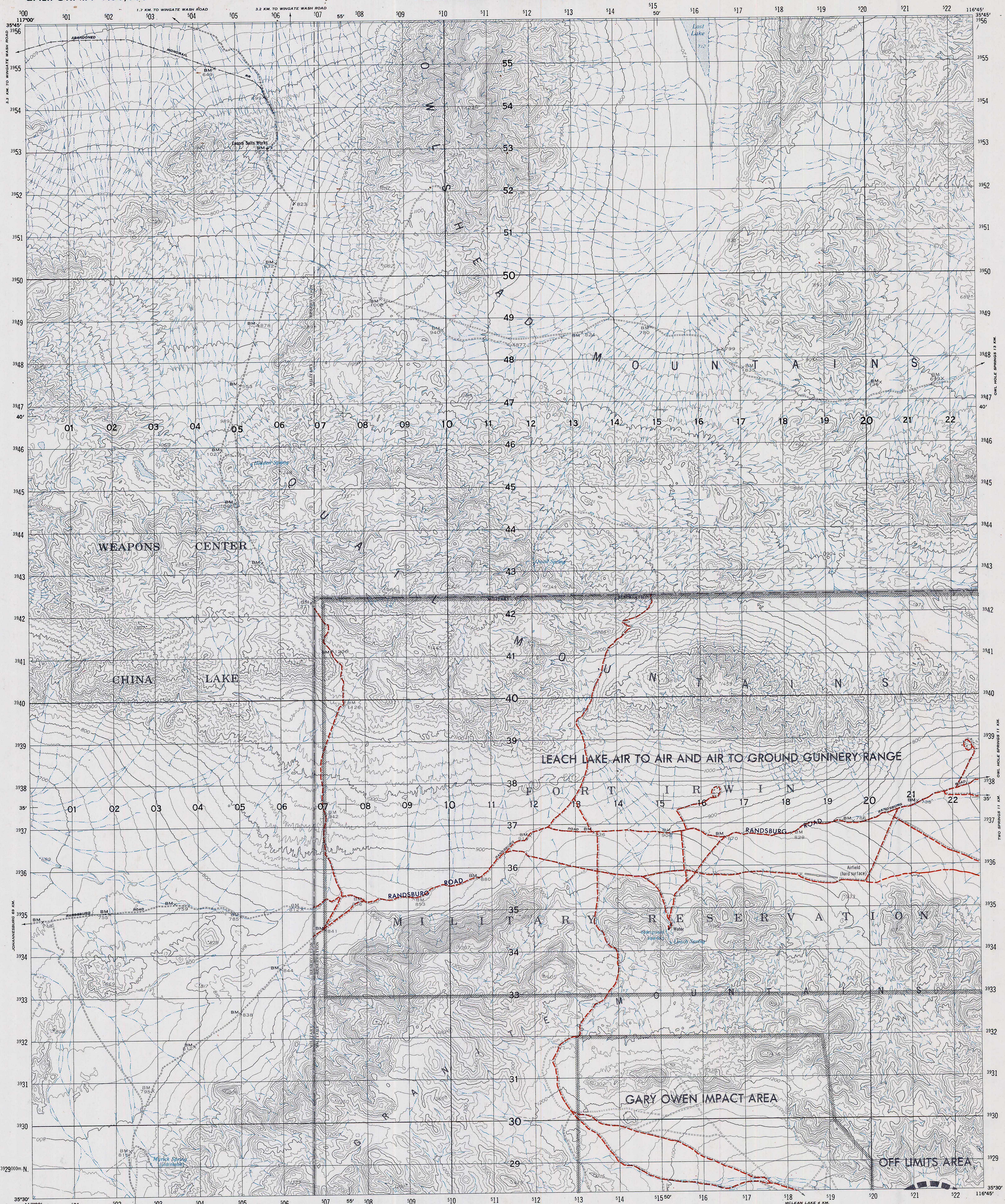
6. DROP ZONES

NAME	GRID REFERENCE	DIMENSIONS	AZIMUTH	ELEVATION	SURFACE DESCRIPTION	REMARKS
GRANITE	NE NK30753700 SE NK30753605 SW NK28003605 NW NK28003700	1400 m X 500 m (4593 ft X 1640 ft)	080° / 260°	610 m (2000 ft)	Low-growing scrub, widely spaced	One vehicle trail crosses DZ.
GOLD FORT	NE NK23402340 SE NK23002290 SW NK20902520 NW NK21402526	3000 m X 700 m (9843 ft X 2297 ft)	130° / 310°	966 m (3170 ft)	Low-growing scrub, widely spaced	One vehicle trail crosses DZ.
FALCON	NE NK37051305 SE NK37051235 SW NK34301220 NW NK34351295	2800 m X 700 m (9186 ft X 2297 ft)	090° / 270°	792 m (2600 ft)	Low-growing scrub, widely spaced	One vehicle trail crosses DZ.
BICYCLE LAKE	NE NK34950510 SE NK35350470 SW NK33450360 NW NK33100360	2450 m X 550 m (8038 ft X 1850 ft)	048° / 228°	716 m (2350 ft)	Low-growing scrub, widely spaced	Bicycle Lake AAF lies in DZ.
LANGFORD WELL	NE NJ32709570 SE NJ32709200 SW NJ31809200 NW NJ31809570	3700 m X 950 m (12139 ft X 3117 ft)	180° / 360°	698 m (2290 ft)	Low-growing scrub, widely spaced	Two vehicle trails cross DZ.

CALIFORNIA 1:50,000

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

SHEET 2655 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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ADJOINING SHEETS

2555 I	2655 IV	2655 I
2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- Airfield
- Airstrip

DROP ZONES

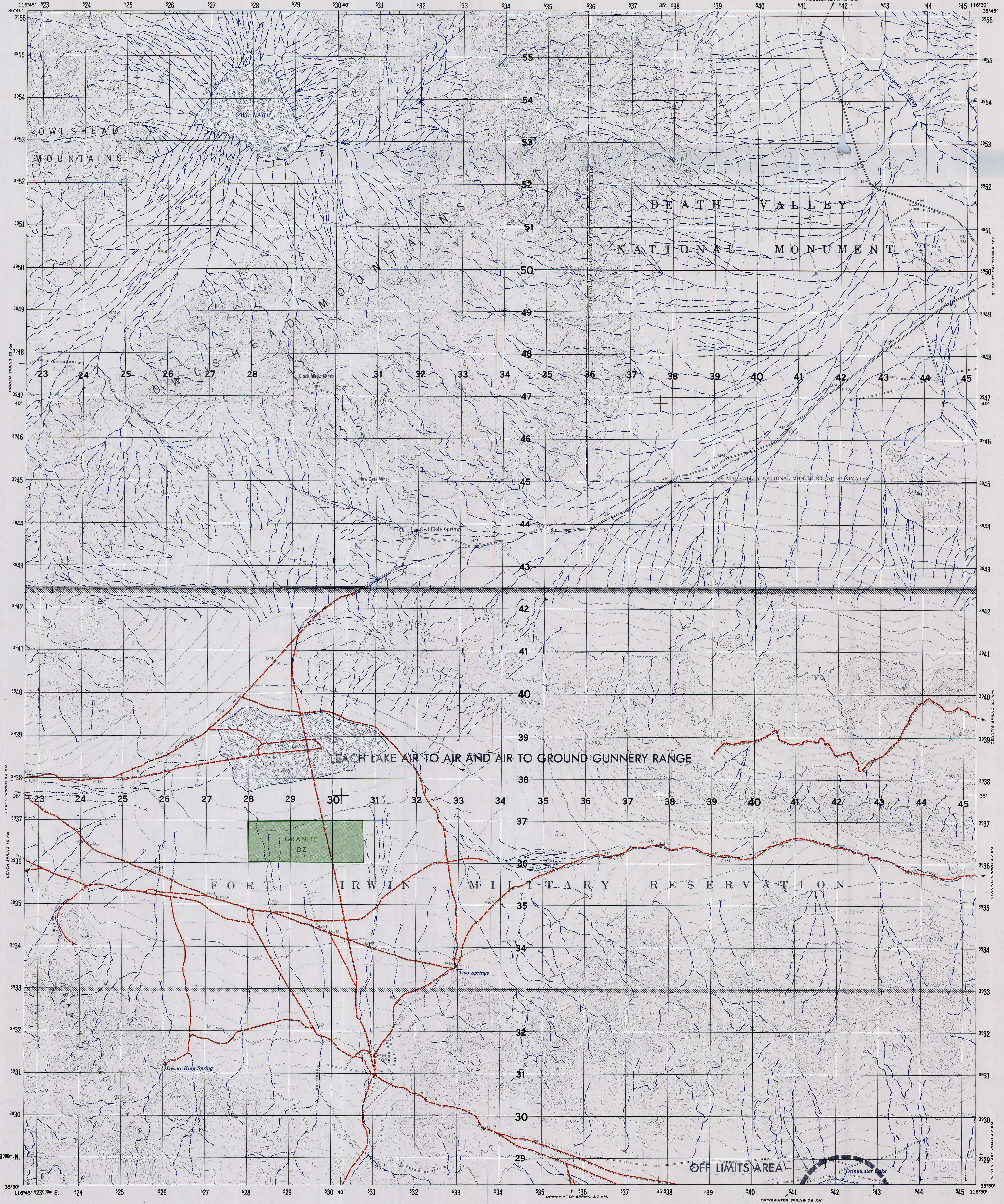
- DZ Drop Zones

Note: Number refers to entry in table.

CALIFORNIA 1:50,000

FORT IRWIN, CALIFORNIA TERRAIN ANALYSIS

SHEET 2655 II



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2655 IV	2655 I	2755 IV
2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

Note: Number refers to entry in table.

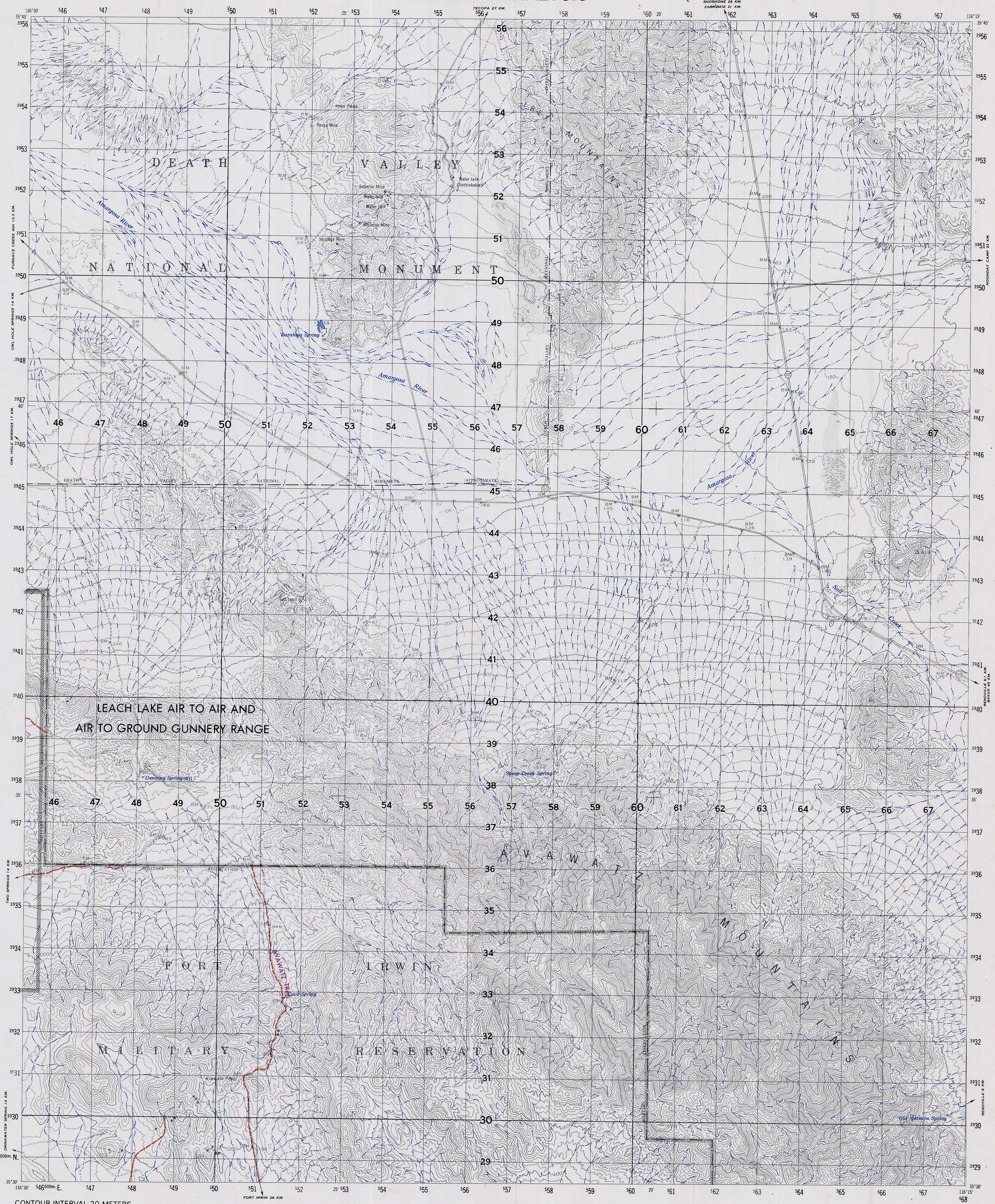
AIRFIELDS / AIRSTRIPS

- 4 Airfield
- 3 Airstrip

DROP ZONES

- DZ Drop Zones

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

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ADJOINING SHEETS

2655 I	2755 IV	2755 I
2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- Airfield
- Airstrip

DROP ZONES

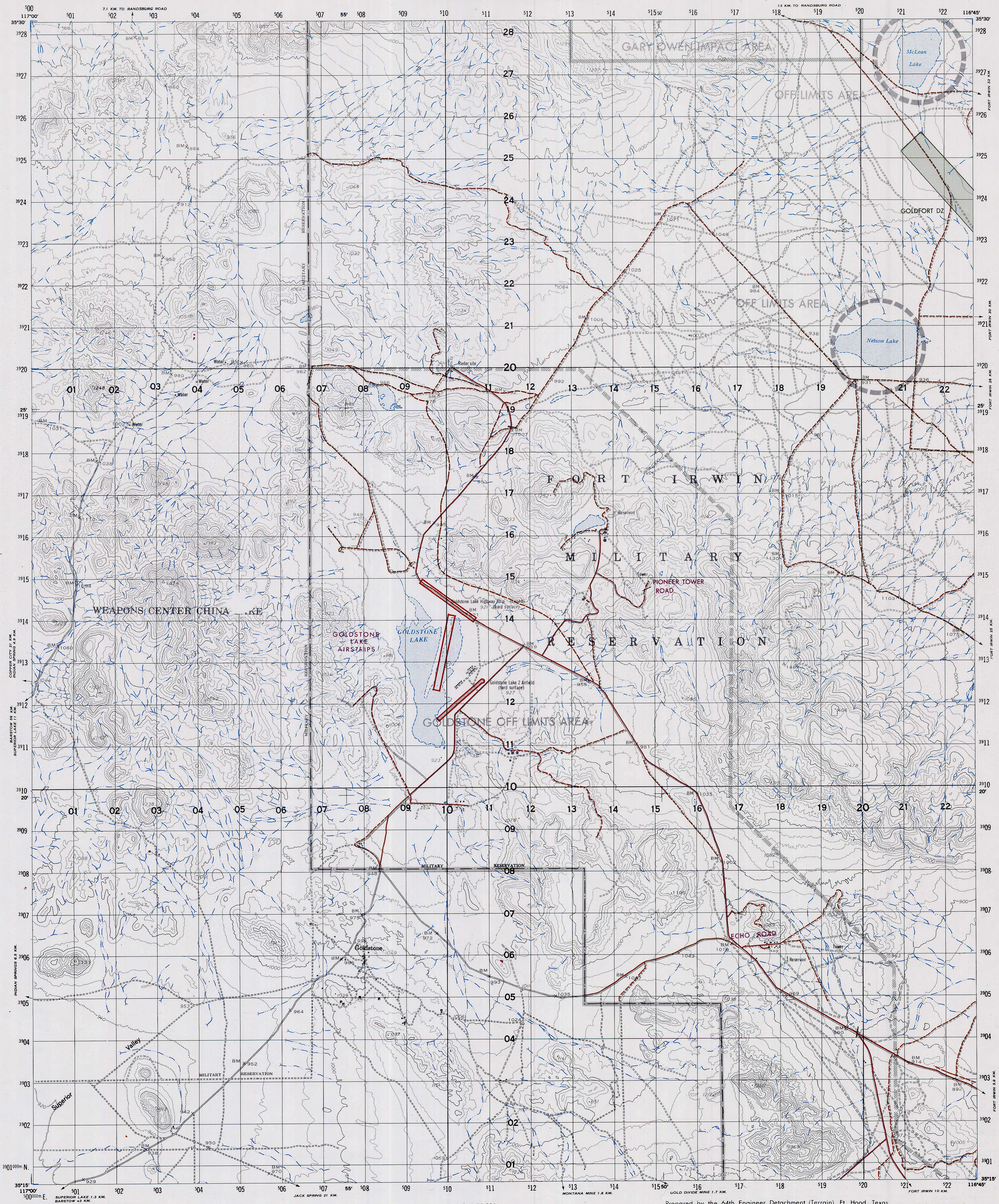
- DZ Drop Zones

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 IV



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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ADJOINING SHEETS

2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- 4 Airfield
- 3 Airstrip

DROP ZONES

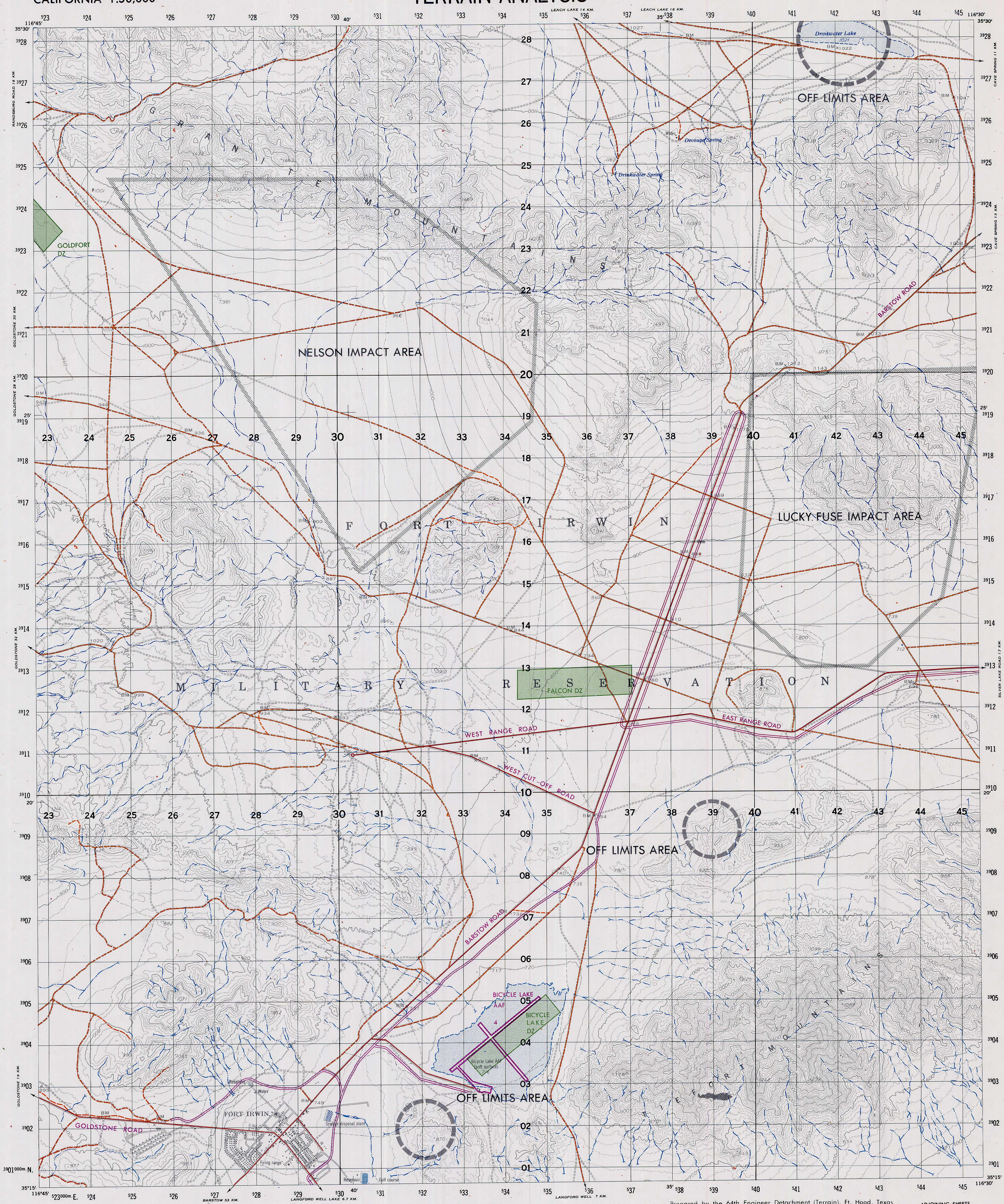
- DZ Drop Zones

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 I



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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ADJOINING SHEETS

2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- Airfield
- Airstrip

DROP ZONES

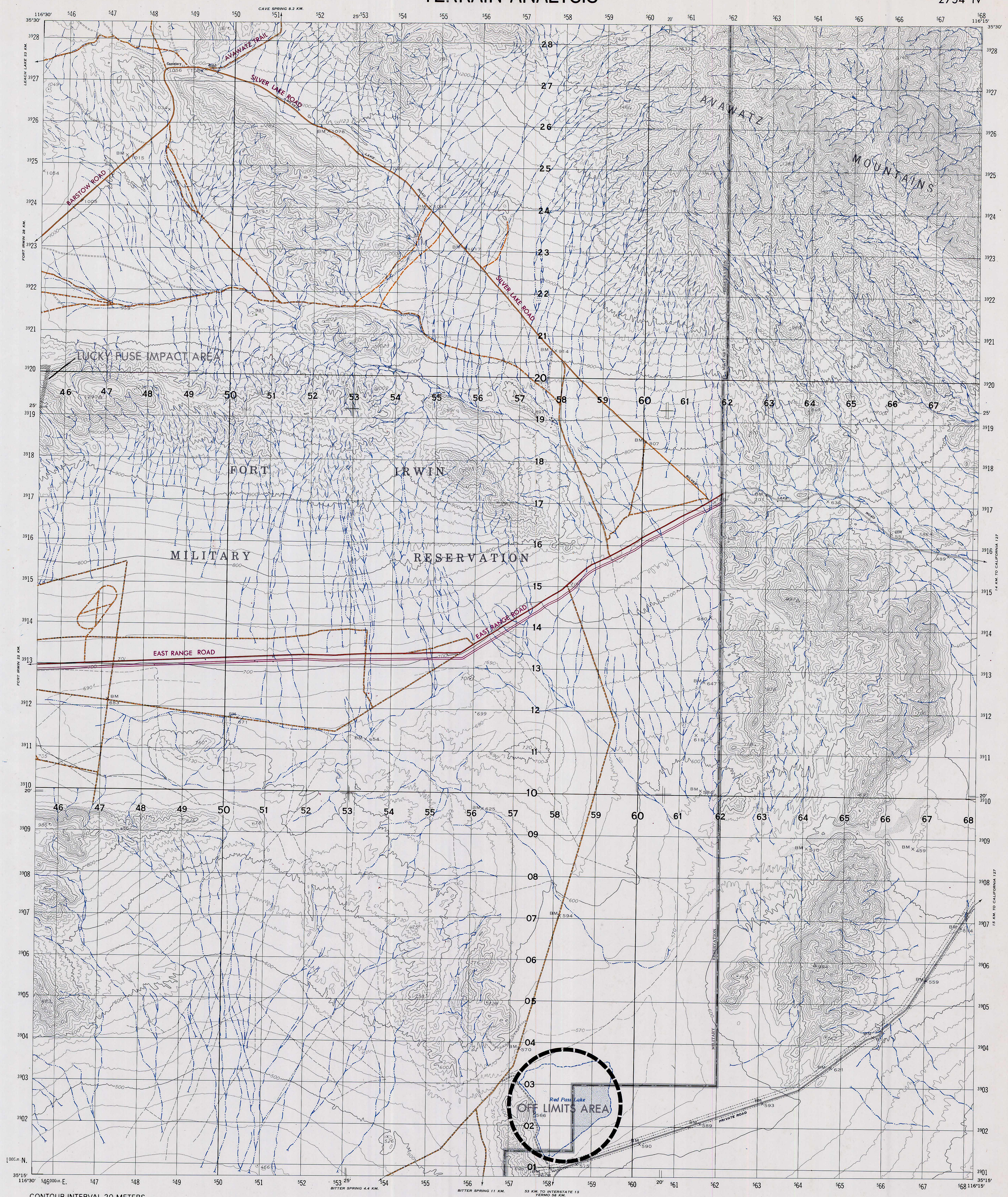
- DZ Drop Zones

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 IV



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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ADJOINING SHEETS

2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- Airfield
- Airstrip

DROP ZONES

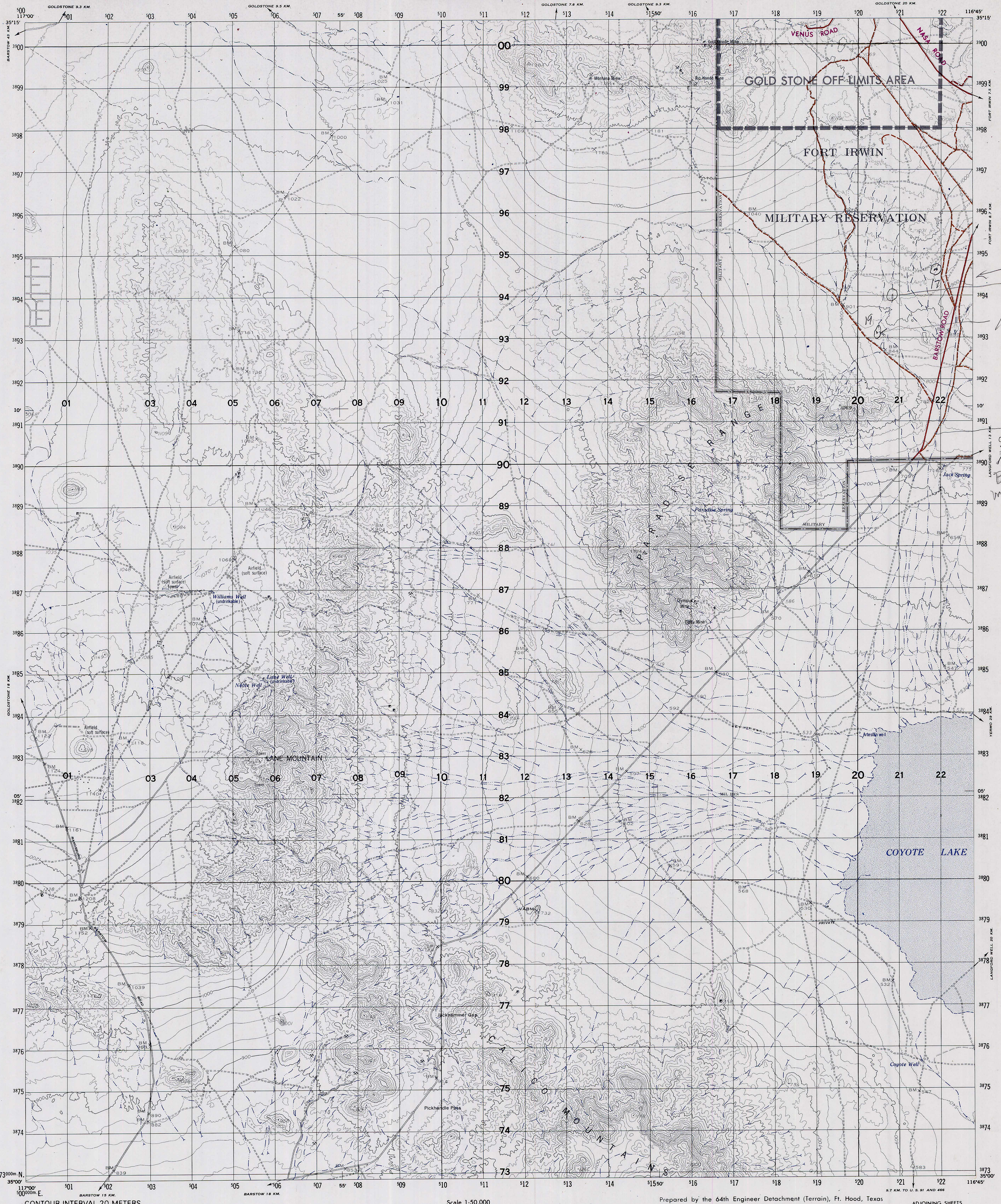
- DZ Drop Zones

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

ADJOINING SHEETS

2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II
2553 I	2653 IV	2653 I

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- Airfield
- Airstrip

DROP ZONES

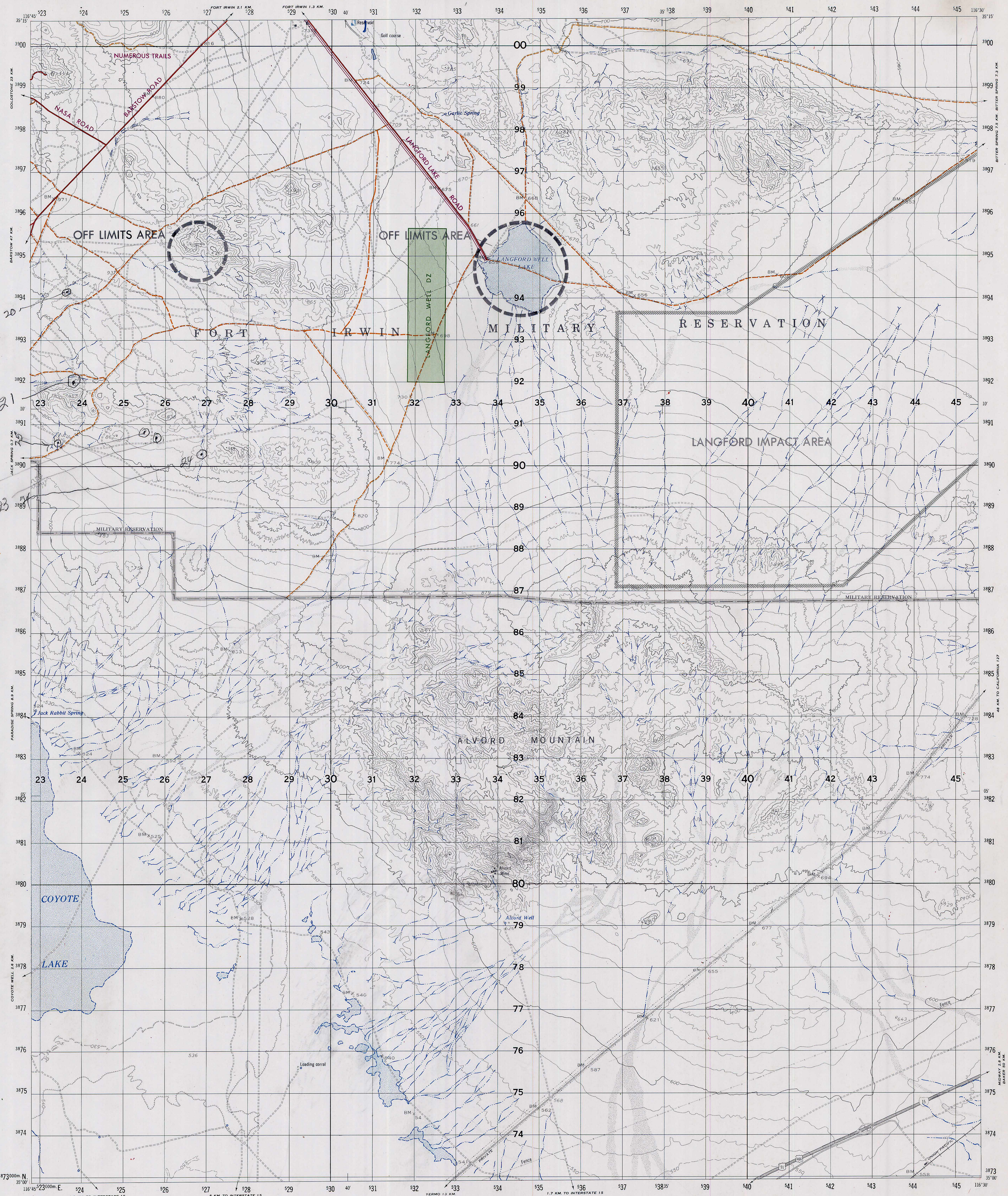
- DZ Drop Zones

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 II



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III
2653 IV	2653 I	2753 IV

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- 4 Airfield
- 3 Airstrip

DROP ZONES

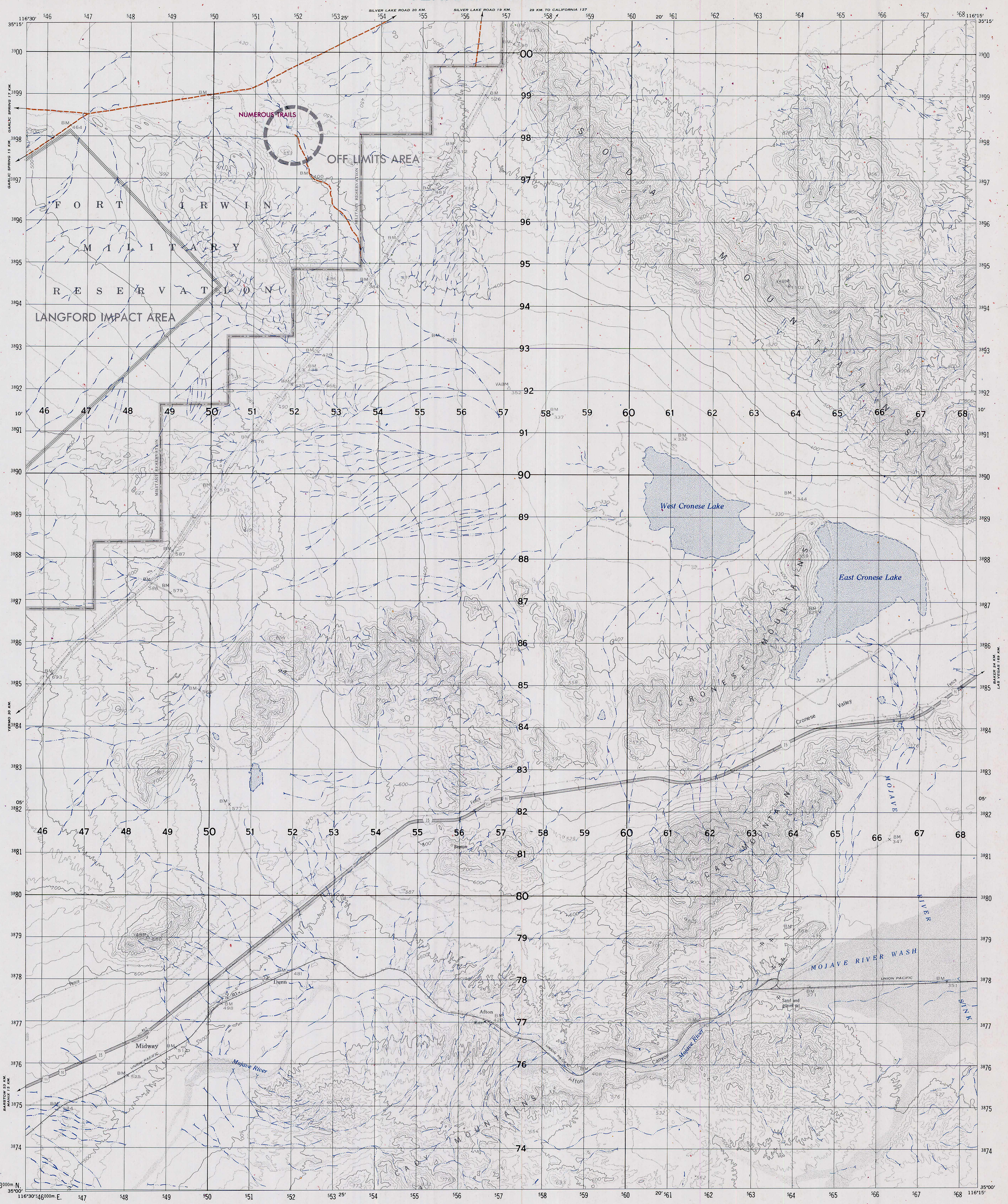
- DZ Drop Zones

Note: Number refers to entry in table.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 III



CONTOUR INTERVAL 20 METERS

SUPPLEMENTARY CONTOURS 10 METERS

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ADJOINING SHEETS

2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II
2653 I	2753 IV	2753 I

LINES OF COMMUNICATION

ROADS

- Hard surface, 2 lanes
- Hard surface, 1 lane
- Improved dirt
- Unimproved dirt
- Tank trail

AIRFIELDS / AIRSTRIPS

- 4 Airfield
- 3 Airstrip

DROP ZONES

- DZ Drop Zones

Note: Number refers to entry in table.

K. URBAN AREAS (CANTONMENT AREAS)

TROOP BILLETS

Permanent

Total number - 3 (Bldg. numbers 273, 275, 226)
Total capacity - Each building has a capacity of 304 men. The combined capacity for all three buildings is 912 men. Square footage figures were not available.
Condition - Generally the condition of each building is good, but work is needed to rehabilitate them. Estimated life of these buildings is to the year 2002.
Remarks - These buildings are a part of the Pierce Barracks complex constructed in 1967. No major maintenance has been performed, and as a result floor tiles are loose, missing, and broken. Walls are scuffed and, in some cases, broken. Fixtures, water closet enclosures and ceramic tiles are missing and broken in the latrines. The entire facility requires painting both inside and out. Several doors and windows are broken in all buildings. Central heating and cooling plants require renovation. Of all the billets 92% are substandard.

Semi-Permanent - none

Temporary

Total number - 36 (Bldg. numbers T411 through T5400)
Total capacity - Each building can accomodate 68 men. The area per building is 582 m² (6265 ft²).
Condition - poor
Remarks - All units are in poor condition with broken windows, holes in walls, broken doors, broken and corroded plumbing. All units need painting. The barracks are scheduled for renovation during FY 1978.
Construction of new, concrete multi-story barracks was planned in the mid-1960's, but deactivation of Fort Irwin in 1970 precluded construction of the new barracks.

QUARTERS

Officer (married)

Total number - 422
Capacity - 169 2-bedroom
253 3-bedroom
Condition - good
Remarks - The vast majority of the housing is abandoned due to the deactivation in 1970. All units have some degree of weathering effects, such as peeling paint, a few broken fences and cracked windows. The grounds around the houses are in good condition with lawns and trees still growing. The permanent party facilities engineers mantain the housing by repairing minor aging effects, and also by periodically watering the transplanted vegetation around the structures.

Enlisted Family Quarters

Total number - 84 (all NCO housing)
Capacity - all units are four bedroom
Condition - good
Remarks - All quarters, officer and NCO, are contained in a single neighborhood area. Enlisted housing is in similar condition as that of the officer quarters, requiring only minor renovation.

Bachelor Enlisted Quarters - Adequate separate facilities for Senior EM (E7 - E9) are non-existent.

Guest Quarters - none

UTILITIES

ELECTRIC POWER

Southern California Edison supplies the electrical power to Ft. Irwin. One 34.5 kV primary service line enters the cantonment area along Barstow Road. A power substation is 4.5 km (2.8 miles) south of the cantonment area where another 34.5 kV service line branches off to the Goldstone Deep Space Communications Complex. There are five power substations on Ft. Irwin which are all owned and operated by Southern California Edison. A system of 12 kV lines serves the individual buildings in the cantonment area.

At present, consumer demand on electrical power is normally very low. During times that large units are training on post the demand may increase several hundred per cent. Power supply by Southern California Edison to Ft. Irwin is adequate at all times. Any possible expansion of the post would not tax the current capabilities of Southern California Edison to deliver power.

GAS

The gas used on Fort Irwin is liquid petroleum propane gas. The distribution system pressure is maintained at 15 P.S.I. through most of the system. All main and service piping is black iron pipe layed an average depth of 76 cm (30 inches).

Presently, the facilities engineer maintains two 113,560 L (30,000 gal) tanks that are owned by the Petrolane Transport Company. These tanks are capable of delivering 623 m³ (22,000 ft³) per hour. Normal distribution is held at 8 lbs per square inch with five vaporizers controlling the flow at 1510 L (400 gal) per hour from each tank. Approximately 7570 L (2000 gal) of propane is considered residual gas held in the manifold and service lines. Pressure regulators are at each building or group of buildings. Service lines are 152 mm (6 inches) in diameter. Individual storage tanks are provided for isolated inhabited areas and are serviced through a local vendor contract. The individual tanks are installed at the following locations: airfield, 3780 L (1000 gal), government owned; sewage plant, 3780 L (1000 gal), vendor owned; golf club house, 1890 L (500 gal), vendor owned; and magazine area, 945 L (250 gal), vendor owned.

Peak consumption during training session of National Guard, Reserve, and Regular Army units is normally in November of each year. Even though the month of January is considered a minimal training month, permanent party resident consumption is relatively high due to colder weather. The following table briefly correlates liters (gallons) to m³ (ft³) of demand at times of highest and lowest consumption.

MONTH/YEAR	TOTAL LITERS (GALLONS) DELIVERED TO HOLDING TANKS	m³ (ft³) CONSUMED	LITERS (GALLONS) CONSUMED
NOV 76	254,250 (67,165)	2575 (91,000)	46,400 (12,264)
JAN 77	365,400 (96,258)	27,300 (965,200)	492,400 (130,080)

WATER SUPPLY

Ft. Irwin is totally dependent upon ground water for its water supply. There are presently eleven active wells in and around the cantonment area which tap water reserves of the Owens River and Mono Lake drainage basins. The quantities of ground water available at various locations in the region are dependent upon the nature of the geologic structures and the hydrologic characteristics of the individual basins, since the recharge is limited to particular basins. Eight of the wells are in the cantonment area and three are near Bicycle Lake. All the wells, except for those at Bicycle Lake, are controlled by an autocon system with controls in building 343. The wells are relatively deep (see Groundwater, p. 23). Shallow wells of about 46 to 61 m (150 to 200 ft) were drilled in 1940, but water encountered at this level was unsuitable for domestic use due to high fluoride concentrations.

Totals of water consumption for November, 1976, show that 72,075,600 L (19,040,410 gal) were used while training units were present at Ft. Irwin. The total consumption for January, 1977, was 53,506,300 L (14,134,920 gal) when fewer units were present.

Water demand by specific area for the month of November, 1976, was as follows:

Family housing	40,680,900 L (10,746,790 gal)
Cantonment area	23,440,300 L (6,192,300 gal)
Wash stands	302,800 L (80,000 gal)

A total of 22,700 L (6000 gal) of defluoridation solution was used for purification purposes.

Five above-ground water storage tanks are near the cantonment area. There are two with capacities of 567,800 L (150,000 gal), two at 757,000 L (200,000 gal), and one with a 3,785,400 L (1,000,000 gal) capacity. One open storage water reservoir is northwest of the cantonment area and contains 3,785,400 L (1,000,000 gal) at high water elevation. Within the boundary of the Goldstone Deep Space Communications Complex there are five above-ground water storage tanks, each having a capacity of 669,060 L (177,000 gal).

SEWERAGE

Ft. Irwin has an influent chlorination system for sewage treatment. A system of 203 mm (8 inch) waste pipe connects the cantonment area with the waste treatment plant. At the treatment plant are five oxidation ponds, six sludge drying beds, and one pumphouse to dispose of treated waste into an open reservoir. The oxidation ponds consist of two 20,441,160 L (5,400,000 gal) ponds, two 1,394,420 L (368,500 gal) ponds, and one 2,026,700 L (535,400 gal) pond. The pumphouse was built in 1961 and is constructed with a concrete foundation, wood frame walls and roof, and contains an area of 37 m² (400 ft²).

At present, the sewage treatment plant is more than adequate for the few people using it. The system has proven adequate in the past during peak training periods when troop population was as high as 12,400 men in 1974.

TELECOMMUNICATIONS

Both cantonment and range communications facilities are substandard and difficult to maintain. The post currently leases a commercial switchboard of limited capacity in order to maintain minimum communications throughout the installation. The range wire communications system has deteriorated and in some cases no longer exists.

The telephone exchange building on post was built in 1970. It consists of concrete foundation, block walls, and built-up roof, and has an area of 387 m² (4171 ft²).

RECREATION FACILITIES

Due to the small population that is permanently stationed at Ft. Irwin, recreational facilities are not numerous. There are no facilities outside the cantonment area. The following table briefly describes the facilities on post.

Bowling Alley - Constructed in 1967. The building has an area of 830 m² (8940 ft²).

Recreation buildings - There are a total of seven recreation buildings constructed from 1944 to 1946. Each consists of concrete foundation and floors, wood framing, asbestos siding and mineral surface roll roofing. These buildings are in need of repair and are currently being utilized as administration and general purpose buildings.

Community Center - Constructed in 1952. Total area of 216 m² (2325 ft²).

Main Library - Constructed in 1962. Total area of 441 m² (4747 ft²).

Youth Center - Constructed in 1953. Total area of 123 m² (1320 ft²).

Golf Course - This facility is no longer used. It is unauthorized for small on-post populations. The club house remains, and the course still exists, although facilities no longer maintain it.

Skill development center - Constructed in 1944. Total area of 890 m² (9670 ft²).

Skill development center - Constructed in 1955. Total area of 111 m² (1200 ft²).

Auto self-help garage- Constructed in 1944. Total area of 345 m² (3716 ft²).

EM Service Club - Constructed in 1953. Total area of 1501 m² (16,160 ft²).

Officer's open mess - Constructed in 1942. Concrete foundation and floor, adobe walls, asphalt shingle roof. Total area of 795 m² (8561 ft²). The club has been remodeled in recent years, and is in good condition.

NCO open mess - Constructed in 1944. Total area of 701 m² (7548 ft²).

Religious Education Center - Constructed in 1953. Total area of 582 m² (6265 ft²). Currently being used as a barracks building with a capacity of 68 service members.

Pool, outdoor - Constructed in 1944, it is approximately 32 m (105 ft) long, 14 m (45 ft) wide and covers an area of 442 m² (4762 ft²). A bath house adjacent to the pool consists of concrete foundation, concrete block walls, and concrete slab roof. It has an area of 374 m² (4027 ft²). The pool is unserviceable.

Pool, outdoor - Constructed in 1968, it has an area of 480 m² (5172 ft²) and consists of a concrete foundation and deck, and gunite concreted pool. The bath house is concrete foundation and floor, corrugated metal walls and built-up roof. It has an area of 259 m² (2788 ft²).

Tennis Courts - Constructed in 1944. Concrete slab and chain link fence. These courts are in poor condition and are considered unserviceable.

Tennis Courts - Constructed in 1959. 10 cm (4 inch) reinforced concrete slab, chain link fence, lighted. The courts are double and have a total area or 134 m² (1440 ft²). These courts are in good condition.

Baseball Field - Constructed in 1967. Chain link fence, dugout, bleachers, and snack bar.

Baseball Field - Constructed in 1944. Grass sodded, sprinkler system, full flood lighting and chain link fence enclosed. The field has an area of 13,430 m² (144,570 ft²).

Skeet Field with trap house - Constructed in 1953. Two buildings, concrete piers, floors, sides, and roofs. Each building has an area of 5 m² (56 ft²).

Theater with stage - Constructed in 1965. Concrete foundation and floors, concrete block walls, steel roof joists with built-up gravel roof. The theater seats 500 and has an area of 860 m² (9271 ft²).

Gymnasium - Constructed in 1958. Steel arch construction, wood frame, concrete floor, hardwood finish floor, plyscore roof and walls. Total area is 1510 m² (16,270 ft²). Building needs minor repairs.

Handball Court - Constructed in 1968. Concrete floor, walls and roof. Total area is 177 m²(1906 ft²). Estimated life of building is to the year 2003.

SCHOOLS AND HOSPITALS

SCHOOLS

A school has been built at Fort Irwin and is situated in the center of the housing area. The buildings are constructed with concrete foundations and concrete walls. The school is designed to carry a combined kindergarten through 12th grade curriculum. The school is closed, but furniture and supplies are kept in site for immediate use if the need arises.

HOSPITALS

Weed Army Hospital is located near the present post headquarters. Constructed in 1968, it is closed, but set up for immediate use. Medical equipment, beds and linens are wrapped in plastic. The building has an area of 3997 m² (43,010 ft²). A large helipad is located adjacent to the hospital. Two dispensaries are presently used in lieu of a hospital. Facilities are totally inadequate for medical treatment during peak training periods.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

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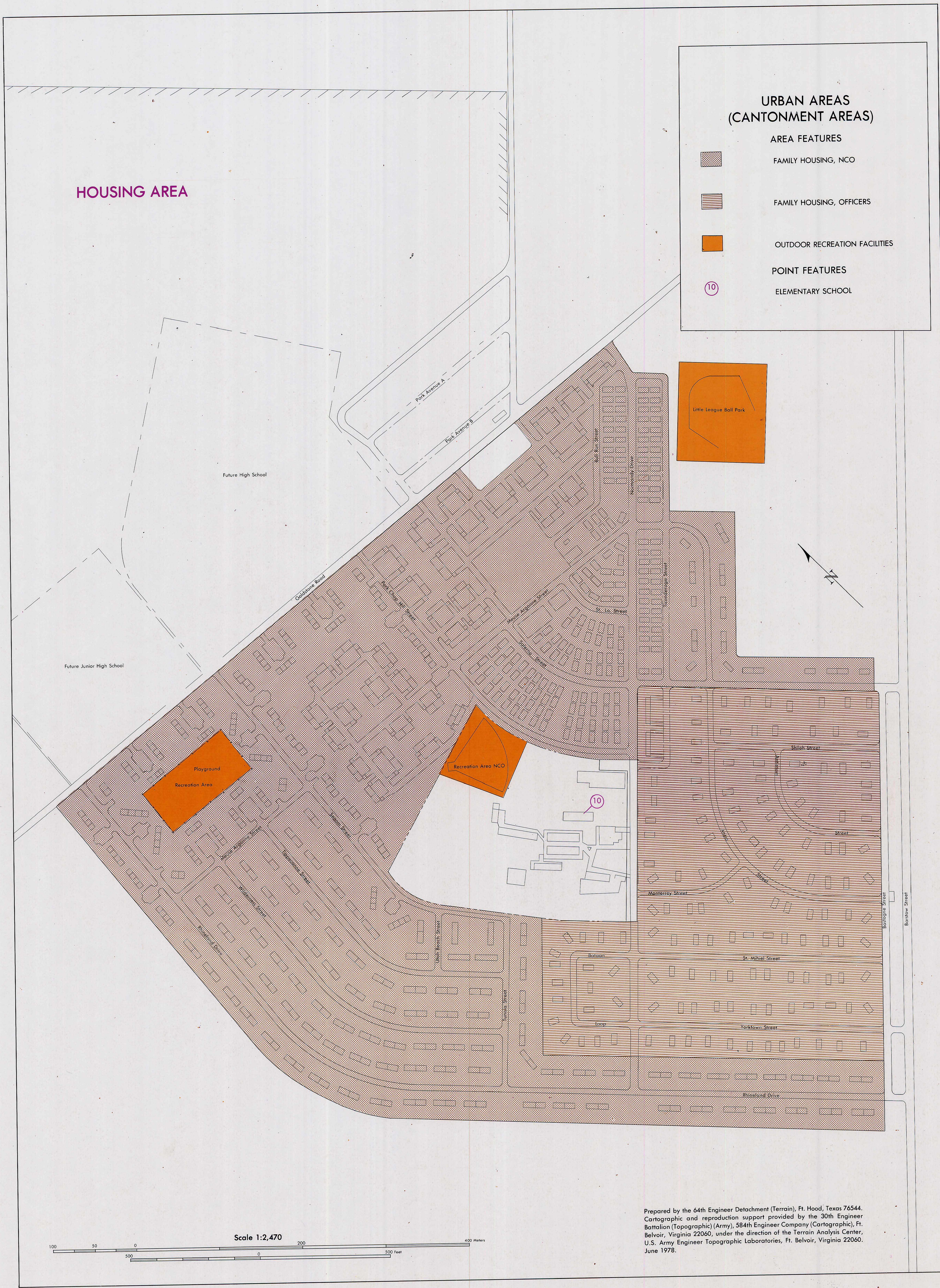
FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



L. NON-URBAN CULTURE FEATURES

On Fort Irwin reservation, there are over 125 manmade features outside the cantonement area which could either positively or negatively affect military training or operations. Most of these features are the different types of electronic equipment to support the Goldstone Space Communications Complex.

The Goldstone Complex, covering about a quarter of the western side of the reservation, is composed of seven stations. The land they occupy was given to NASA-Goddard in 1956 under a land permit from the U.S. Government when Fort Irwin was a temporary Army installation.

MAP NUMBER	GRID REFERENCE	DESCRIPTION
		SHEET 2655 III
1	NK15183456	Above ground water storage tank; no description available.
2	NK15153452 to NK15243424	Underground aqueduct; no description available.
		SHEET 2655 II
3	NK23433446	Vertical mine shaft.
4	NK23903413	Vertical mine shaft.
5	NK26053115	Building; located near Desert King Spring, no description available.
6	NK39003853	Vertical mine shaft.
		SHEET 2755 III
7	NK51553294	Ruins; several small man-made caves, one containing an active spring. Remnants of old buildings such as concrete foundations, pieces of wood. No structures are standing.
8	NK51843265	Vertical mine shaft.
9	NK51493210	Vertical mine shaft.
10	NK47752925	Vertical mine shaft.
11	NK49023005 NK48952990 NK48572970	Three vertical mine shafts.
12	NK49473051 NK49523045 NK49583035	Three vertical mine shafts.
13	NK49952930 NK49822920 NK50022913 NK50102913	Four vertical mine shafts.
		SHEET 2654 IV
14	NK09882095	Microwave tower.
15	NK10152005	Antenna (dish-type); 64m (210 ft) diameter; mounted on 25m (82 ft) diameter pedestal for azimuth and elevation. Antenna and pedestal built on top of two-story building and alidade.
16	NK09651988	Microwave tower; 91.4m (300 ft) high.
17	NK10491983	Guard house at entrance to MARS site.
18	NK09971988	Power substation of Southern California Edison.
19	NK11051828	Water tank; 7.3m (24 ft) high, 10.9m (36 ft) in diameter. Capacity 669,060 L (177,000 gal).
20	NK07511917	Microwave tower; approximately 5.5m (18 ft) high.
21	NK11001830 to NK10171995	Underground pipeline, water; 20.3m (8 inch) diameter.
22	NK12541724 NK12451710	Two microwave towers.
23	NK13601614	Antenna (dish-type); 9m (30 ft) diameter antenna mockup.
24	NK13951656	Dump area for scrap wood and unserviceable equipment.
25	NK13801590	Antenna (dish-type); 26m (85 ft) diameter.
26	NK09951990 to NK20050330	Power line; overhead, 12.5 kV.
27	NK07161625 NK07451575 NK07521560	Three buildings, no description.
28	NK07791635 NK08811565	Two buildings; no description.
29	NK12841594 NK12971584	Five concrete blocks, approximately 6.1m³ (261 ft³) each.
30	NK13641602	Power substation of Southern California Edison.
31	NK13641595 NK13401488	Underground pipeline, water; 20.3mm (8 inch) diameter.
32	NK07881206	Trailer; mobile home approximately 7.6m (25 ft) long.
33	NK10231410 to NK09851256	Abandoned airfield; alignment 013° /193° . Unimproved surface on dry lake bed. Old tires mark runway alinement.
34	NK10281420	Two buildings; one is 9.4m (31 ft) by 4.9m (16 ft) concrete block. The other is 3.7m (12 ft) by 7.3m (24 ft) concrete block. Parking area for aircraft of approximately 3700m² (40,000 ft²) and gas pump behind buildings.
35	NK13271448	Water tank; 7.3m (24 ft) high, 11.0m (36 ft) in diameter. Capacity is 669,060 L (177,000 gal).
36	NK27230182 to NK11761324	Telephone line; overhead.
37	NK14901497	Tower, collimation; 30.4m (100 ft) high. Three fixed antennas; tower has hoist and spiral staircase; concrete block building at base of tower is 2.7m (9 ft) by 11.9m (39 ft).
38	NK10251246 NK10571286	Six concrete bunkers probably used for ordnance research and development; now abandoned.
39	NK07561182	Tower, collimation; 30.4m (100 ft) high. Concrete block building at base of tower is 5.8m (19 ft) by 4.3m (14 ft). A small, fenced area behind building is 2.4m (8 ft) by 3m (10 ft).
40	NK10771240	Building; located near new airstrip at Goldstone Lake. Wood frame, 1.8m (6 ft) by 2.1m (7 ft). Small weather station on 4.6m (15 ft) pole next to building. Windsock on 8.5m (28 ft) pole 24.4m (80 ft) SW of building.
41	NK13431273 to NK10490970	Power line; overhead, 34.5 kV.
42	NK12751082 to NK10340957	Underground pipeline, water; 20.3m (8 inch) diameter.
43	NK11691083	Antenna (dish-type); 26m (85 ft) diameter. Pedestal mounted for azimuth and elevation.
44	NK12751082 to NK14201135	Underground pipeline, water; 152 mm (6 inch).
45	NK07871090	Vertical panel with steel supports. Approximately 4.9m (16 ft) by 6.1m (20 ft). Use unknown.
46	NK11521064	Antenna (dish-type); 10.7m (35 ft) diameter. Pedestal mounted for azimuth and elevation.
47	NK12751082	Water tank; 7.3m (24 ft) high, 11.0m (36 ft) in diameter. Capacity is 669,060 L (177,000 gal).
48	NK12941010	Tower, collimation; 32.6m (107 ft) high. Concrete block building at base of tower is 2.7m (9 ft) by 3.7m (12 ft). Paved road to site. Concrete driveway to building approximately 12.2m (40 ft) long.
49	NK07300850	Sanitary fill.
50	NK07900865	Ruins; six concrete slabs. Wood debris scattered throughout area. No standing buildings.
51	NK10400926	Dump area for scrap wood and unserviceable equipment.
52	NK10480970	Antenna (dish-type); pedestal mounted. No dimensions available.
53	NK13500872	Tower, collimation; 26.8 m (88 ft) high. Concrete block building at base of tower is 2.7m (9 ft) by 3.7m (12 ft). Paved road to tower.
54	NK17430645 to NK17910623	Underground pipeline, water; 20.3m (8 inch) diameter.
55	NK17240714 NK17530690 NK17350676	Buildings; no description.
56	NK17400650	Water tank; 7.3m (24 ft) high, 11.0m (36 ft) in diameter. Capacity is 669,060 L (177,000 gal).
57	NK19390652	Tower, collimation; 61 m (200 ft) high. Fixed 2.4m (8 ft) antenna with hoist and spiral staircase. Concrete block building at base of tower is 5.2m (17 ft) square.
58	NK17770654	Microwave tower; no description.
59	NK17840605	Antenna (dish-type); 26m (85 ft) in diameter. Pedestal mounted for azimuth and elevation.
60	NK17350574 to NK17800613	Power line; overhead, 12.5 kV.
61	NK13701590 to NK20000342	Power line; overhead, 12.5 kV
62	NK19600428	Security building at entrance to Goldstone Deep Space Communications Complex; contains 32.0 m² (342 ft²).
63	NK20800370	Building; no description.
64	NK20000342	Power substation of Southern California Edison.
65	NK19700365 to NK18850037	Power line; overhead, 12.5 kV.
66	NJ21129995 to NK11001830	Underground pipeline, water; 152mm (6 inch) diameter.

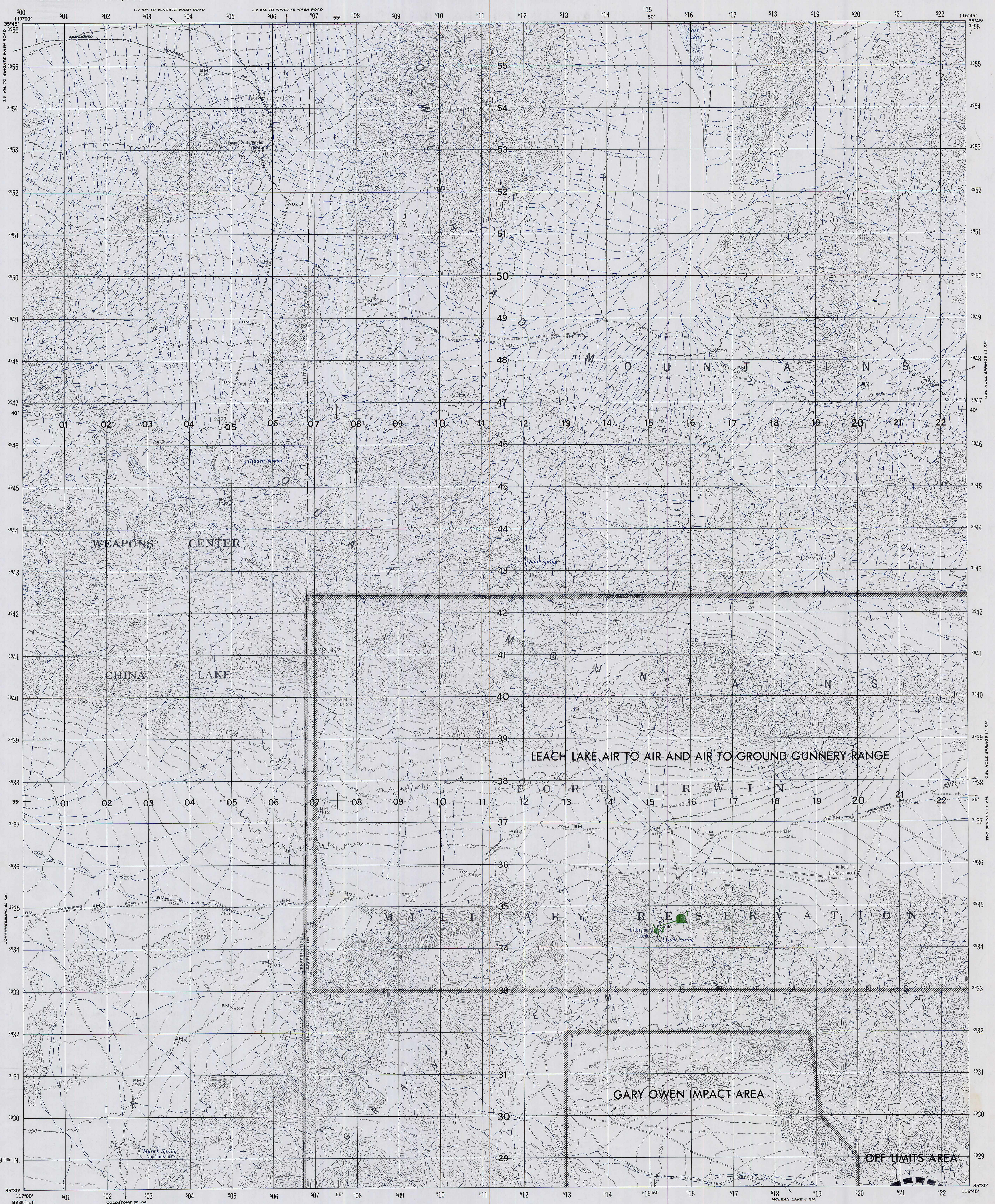
L. NON-URBAN CULTURE FEATURES (Continued)

MAP NUMBER	GRID REFERENCE	DESCRIPTION
		SHEET 2654 I
67	NK38182562	Water tank; no description available.
68	NK40672000	Monument; approximately 1 m (3 ft) high with an inscription citing an engineer battalion that constructed the road through the mountains at this location.
69	NK38621594	Cemetery, one grave. Known locally as Connally's Grave.
70	NK42551268	Tower; range control, observation bunkers and three latrines associated with range.
71	NK38900800	Building; Continental telephone building for microwave tower; building is 4m (13 ft) by 2.9 m (9.5 ft) by 3.7m (12 ft). A chain-link fence surrounds building and is 13m (43 ft) by 24.4m (80 ft).
72	NK38920804	Microwave tower; 3.7 m (12 ft) high. Two circular antennas. Tower sits atop building.
73	NK28860240 to NK38920804	Power line; overhead, 12 kV.
74	NK33670693 to NK38960395	Power line overhead, 12 kV.
75	NK30640426	Power substation of Southern California Edison.
76	NK29200240 to NK35300704	Underground pipeline, water 406 mm (16 inch) and 152 mm (6 inch) diameters.
77	NK30980420	Water tank; 1,892,700 L (500,000 gal).
78	NK30840415	Booster pump station, 83.6 m² (900 ft²), associated with reservoir tank for water drawn from Bicycle Lake wells.
79	NK30640426 to NK33500175	Power line; overhead, 12 kV.
80	NK38960395	Tower, collimation; two 3m (10 ft) towers with hoist and ladder. Concrete block building near towers. Equipment must be serviced by helicopter.
81	NK27940286	Water tank; 567,800 L (150,000 gal).
82	NK31660290	Building; concrete block, 2.7 m (9 ft) by 4.3 m (14 ft).
83	NK31710294	Radio tower; 15.2m (50 ft) high.
84	NK33370294	Bicycle Lake Army Airfield operations center; aircraft maintenance hangar and flight control tower are contained within a one-story building; parking apron for aircraft near building.
85	NK25700195	Ammunition bunkers; a complex of 32 ready magazines. All built with concrete floors, metal walls and roof. The following is the area of each bunker: 1 each with 891.8m² (9600 ft²), 10 each with 92.9m² (1000 ft²), 11 each with 72m² (776 ft²), 7 each with 59.3m² (638 ft²), 3 each with 12.4m² (133 ft²). Chain-link fence surrounds complex.
86	NK26420197	Pumping station, water; feeds a 152mm (6 inch) diameter waterline to Goldstone Deep Space Communications Complex.
87	NK26530195	Water tank; 3,785,400 L (1,000,000 gallons). Steel tank, 26 m (85 ft) diameter, 8m (25 ft) high, with 5m (16 ft) gate valve. Concrete foundation and ring wall.
88	NK30500080	Sewage disposal plant; five oxidation ponds, two 20,441,160 L (5,400,000 gal) ponds; two 1,394,420 L (368,500 gal) ponds; and one 2,026,700 L (535,400 gal) pond.
89	NK29050209 to NK29780236 and NK29570145 to NK30220080	Power line, overhead; 2 lines, 12 kV.
90	NK26560193 to NK26980190	Power line, overhead; 12 kV.
91	NK30270096	Sewage disposal plant; wood frame building with transite siding and roll roofing. Dimensions are 3m (10 ft) by 2.4m (8 ft). Building houses contact chamber and gauges for influent chlorination system.
92	NK33500176	Radio tower; no description available.
93	NK27730304	Reservoir, water storage. Capacity is 3,785,400 L (1,000,000 gal). Concrete underground tank with metal columns, wood frame roof, 5 ply roll roofing and tar.
		SHEET 2754 IV
94	NK48722735	Cemetery; single grave. Known locally as 'Anderson's Grave.'
95	NK54442448, NK54462440, NK54502443	Buildings; three range control buildings. Individual descriptions not available.
96	NK46751360	Building; wood frame, approximately 30 years old. Condition of building is poor.
97	NK46941310	Building; steel shed and concrete floor, 61.3 m² (660 ft²). Built in 1951 as a motor vehicle shop, now used as a training course structure.
98	NK48251320	Tower, range control. Wood frame, approximately 6.7m (22 ft) high. Building near tower built in 1953, has concrete foundation, floor, wood frame, gypsum sheathing, asbestos cement siding, and gravel build-up roof. Area is 232.2m² (2,500 ft²).
99	NK48851323	Tower, range control for East Range Number 1. There are 10 firing points for .30 and .50 caliber, and 7.62mm weapons.
100	NK49451325	Tower, range control for East Range Number 2. Tower built in 1968, wood frame, concrete foundation. The range has 10 firing points for 90mm, 76mm, 106mm recoiless rifle.
101	NK50381327	Tower, range control for East Range Number 3. Tower built in 1968, wood frame, concrete foundation. The range has 10 firing points for .30 and .50 caliber, and 7.62mm weapons.
102	NK51201335	Tower, range control for East Range Number 5. Tower built in 1968, wood frame. The range has 10 firing points for .30 and .50 caliber, and 7.62 mm weapons.
103	NK37101160 to NK54552440	Telephone line; overhead.
104	NK46531260	Tower, range control; wood frame, approximately 6.7 m (22 ft) high.
105	NK48371278 NK48251305 NK48371305 NK48901310	Buildings, associated with Ranges 1 and 2 on East Range Road. Of the four buildings, one is a training structure built in 1953; concrete foundation and floor, wood frame, gypsum sheathing, asbestos siding and built-up gravel roof; area of structure is 232.2m² (2,500 ft²). Another training structure, built in 1956, has concrete foundation and floor, aluminum roof and steel siding; area of structure is 223.0m² (2,400 ft²). An enlisted personnel mess at Range 1 was built in 1946, and has wood block foundation, wood floor, asbestos siding, wood roof with paper covering; area of structure is 105.3m² (1,134 ft²). The fourth building, a training structure, has the same characteristics as the first building in this entry.
106	NK49551315 NK49641314	Buildings, associated with East Range Number 3. Enlisted personnel mess Building constructed in 1946; wood block foundation floor, asbestos siding, wood roof, paper covered; area is 105.3m² (1,134 ft²). Training structure built in 1953; concrete foundation and floor, wood frame, gypsum sheathing, asbestos siding, gravel built-up roof; area is 232.2m² (2,500 ft²).
107	NK50351315	Building, associated with East Range Number 4; built in 1953; concrete foundation and floor, wood frame, gypsum sheathing, asbestos siding, gravel built-up roof; area is 232.2m² (2,500 ft).
108	NK51051315 NK51201310 NK51201325	Buildings, associated with East Range Number 5. Enlisted personnel mess was built in 1964; wood block foundation, wood floor, asbestos siding, wood roof, paper covered; area is 105.3m² (1,134 ft²). Two other buildings nearby are new latrines; concrete floor, steel siding and roof.
		SHEET 2654 III
109	NK18750020 NK18750030 NK18750040	Buildings, associated with 'Venus' site as an extension of the Goldstone Deep Space Communications Complex.
110	NK18800021 to NK19469995	Pipeline, underground, water; 203mm (8 inch) diameter line from water storage tank to Venus site.
111	NK18400030	Antenna (dish-type); 26m (85 ft) diameter. Pedestal mounted for azimuth and elevation.
112	NK16800015	Tower, collimation; height 30.5m (100 ft) with fixed 2.4m (8 ft) diameter antenna, hoist and spiral staircase.
113	NJ19409995	Water tank; 7.3m (24 ft) high, 10.9 m (36 ft) in diameter. Capacity is 669,060 L (177,000 gal).
114	NJ19469995 NK26420197	Pipeline, underground, water; 152 mm (6 inch) diameter line running from water storage tank at Venus site to pumping station near Ft. Irwin housing area on Goldstone Road.
		SHEET 2654 II
115	NK26650051	Water tanks, three in a triangular cluster. Capacity of one tank is 567,800 L (150,000 gal) and the other two at 757,000 L (200,000 gal).
116	NJ21159015 to NK27550085	Power line, overhead; 34.5 kV.
117	NJ23299936	Microwave tower; owned by a Continental Telephone; building is concrete block and is 3.0 m (9.5 ft) by 3.7 m (12 ft) by 3.7 m (12 ft). Tower is built on roof of building and is 15.3m (50 ft) high with two disc antennas; chain-link fence around buil[illegible] is 16.8m (55 ft) by 26.6m (87 ft); paved road leads up hill to stati[illegible] [illegible]ASA Road.
118	NK20000342 to NK24389760	Power line, overhead; 34.5 kV.
119	NJ24389757	Power substation of Southern California Edison.
120	NJ22109030 to NJ24389760	Power line, overhead; 34.5 kV.
121	NJ24259730	Building, MP checkpoint at main gate; built in 1967 with concrete foundation and floor, ungalvanized corrugated metal siding and mineral surface roll roofing; area of 5.8m² (62 ft²).
122	NJ22869562	Building, use unknown; no description available.
123	NJ26589525	Radio tower, TV transmitter station; building is 2.7 m (9 ft) by 3.7m (12 ft) concrete block. Two towers adjacent building, each made of three telephone poles, with antennas, one tower is 9.2 m (30 ft) high, the other is 15.3m (50 ft); small fenced area 2.1m (7 ft) by 2.4m (8 ft) located approximately 40.0m (130 ft) west of building.
124	NJ30899759	Tower, range control for M79 LAW Range. Tower is wood frame, concrete foundation, 6.7 m (22 ft) high; temporary bleacher located 15.2m (50 ft) NE of tower.
125	NJ30449630	Tower, range control; wood frame, concrete foundation, 6.7m (22 ft) high.
126	NJ35239262	Tower, use unknown; tubular metal legs set up in triangular fashion, 4.9 m (16 ft) high.
127	NJ39509446	Bunker, open sides with roof; roof supported with various sized bridging timbers.
128	NJ40959490	Bunker, open sides with roof; roof supported with various sized bridging timbers.
		SHEET 2754 III
129	NJ47109842	Tower, use unknown; tubular metal legs set up in triangular fashion, 4.9 m (16 ft) high.
130	NJ51829817	Monument, to explorer Jedediah Smith; plaque is attached to bridge timber standing upright in ground; approximately 2.1 m (7 ft) high. Monument is near Bitter Springs, one of the few springs in this region.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2655 III



CONTOUR INTERVAL 20 METERS
SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

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ADJOINING SHEETS

2555 I	2655 IV	2655 I
2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I

NON-URBAN CULTURE FEATURES

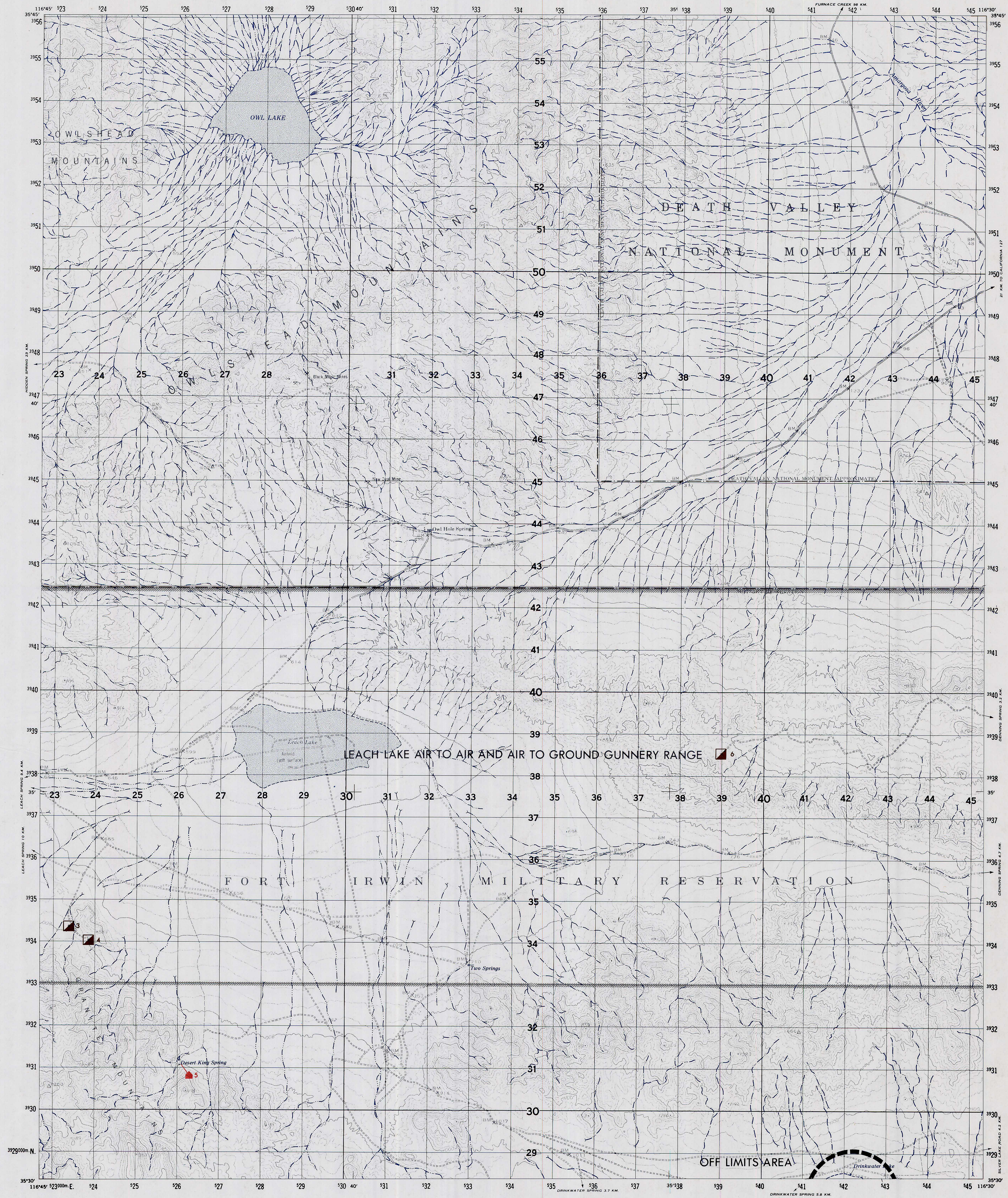
W WALL	MONUMENT	RUINS	PIPELINE
BUILDING	POWER LINE	B BUNKERS	SMALL CEMETERY
RADIO TOWER	TELEPHONE LINE	SF SANITARY FILL	TRAILER LOCATION
MICROWAVE TOWER	ABANDONED AIRSTRIP	OX OXIDATION POND	WATER TANK
POWER SUBSTATION	AMMUNITION BUNKER	DISH—TYPE ANTENNA	P PUMPING STATION
UK TOWER, USE UNKNOWN	TOWERS, LOOKOUT, GUARD, FIRE	VERTICAL MINE SHAFT	SD SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2655 II



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SUPPLEMENTARY CONTOURS 10 METERS

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ADJOINING SHEETS

2655 IV	2655 I	2755 IV
2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV

NON-URBAN CULTURE FEATURES

WALL	MONUMENT	RUINS	PIPELINE
BUILDING	POWER LINE	BUNKERS	SMALL CEMETERY
RADIO TOWER	TELEPHONE LINE	SANITARY FILL	TRAILER LOCATION
MICROWAVE TOWER	ABANDONED AIRSTRIP	OXIDATION POND	WATER TANK
POWER SUBSTATION	AMMUNITION BUNKER	DISH—TYPE ANTENNA	PUMPING STATION
TOWER, USE UNKNOWN	TOWERS, LOOKOUT, GUARD, FIRE	VERTICAL MINE SHAFT	SEWAGE DISPOSAL PLANT

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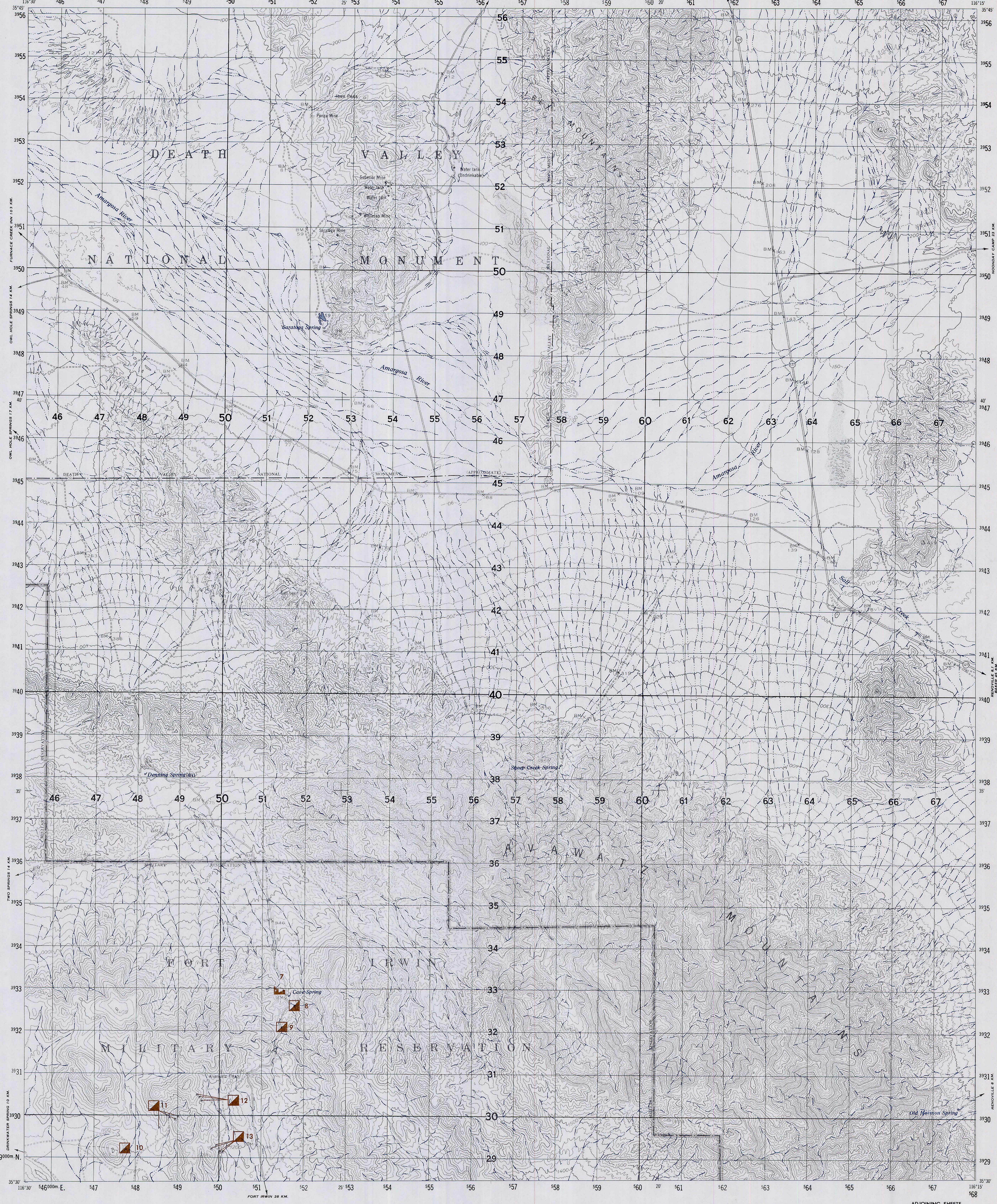
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2755 III



CONTOUR INTERVAL 20 METERS
SUPPLEMENTARY CONTOURS 10 METERS

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ADJOINING SHEETS

2655 I	2755 IV	2755 I
2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I

NON-URBAN CULTURE FEATURES

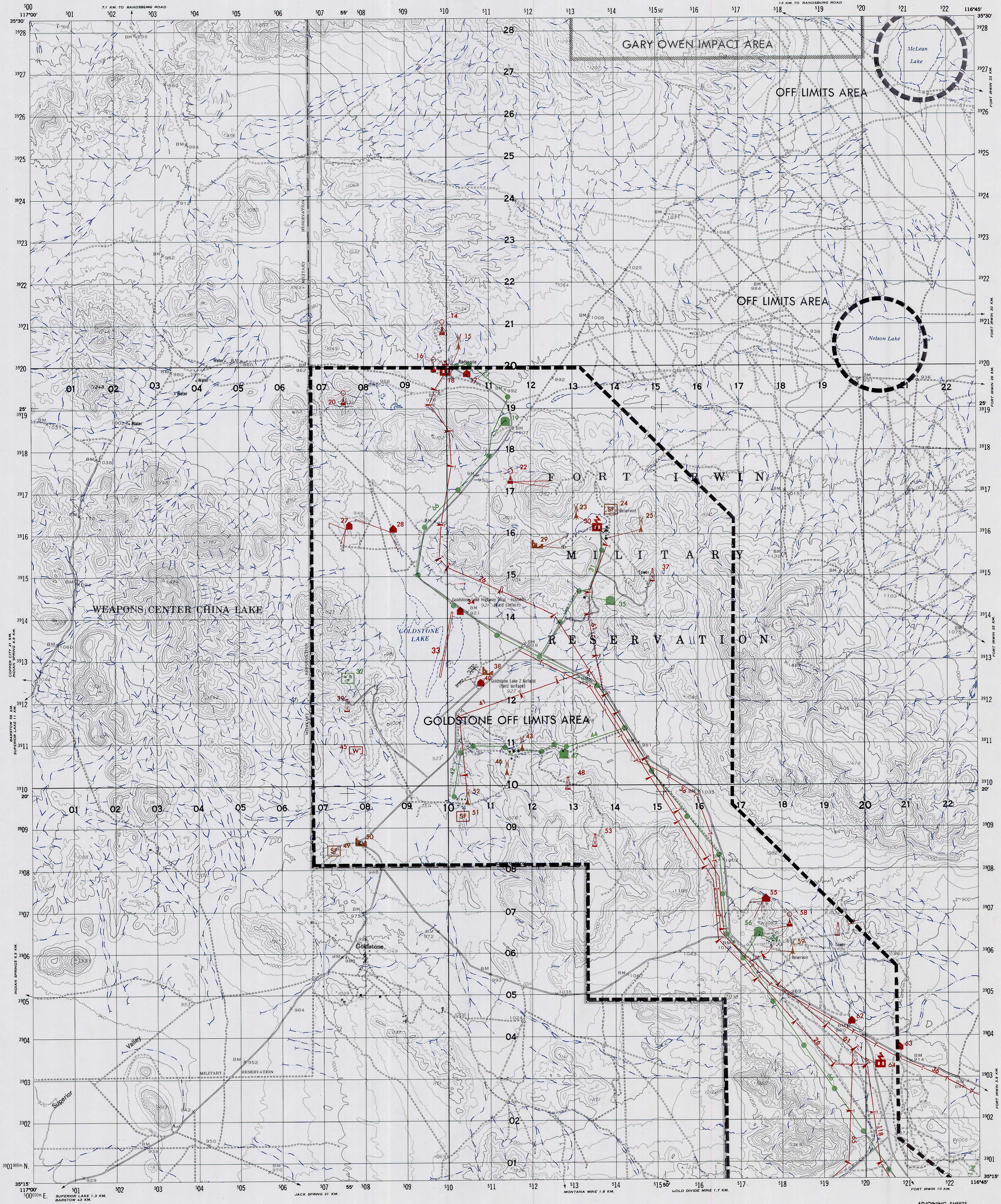
WALL	MONUMENT	RUINS	PIPELINE
BUILDING	POWER LINE	BUNKERS	SMALL CEMETERY
RADIO TOWER	TELEPHONE LINE	SANITARY FILL	TRAILER LOCATION
MICROWAVE TOWER	ABANDONED AIRSTRIP	OXIDATION POND	WATER TANK
POWER SUBSTATION	AMMUNITION BUNKER	DISH—TYPE ANTENNA	PUMPING STATION
TOWER, USE UNKNOWN	TOWERS, LOOKOUT, GUARD, FIRE	VERTICAL MINE SHAFT	SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 IV



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SUPPLEMENTARY CONTOURS 10 METERS

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ADJOINING SHEETS

2555 II	2655 III	2655 II
2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II

NON-URBAN CULTURE FEATURES

- WALL
- BUILDING
- RADIO TOWER
- MICROWAVE TOWER
- POWER SUBSTATION
- TOWER, USE UNKNOWN
- MONUMENT
- POWER LINE
- TELEPHONE LINE
- ABANDONED AIRSTRIP
- AMMUNITION BUNKER
- TOWERS, LOOKOUT, GUARD, FIRE
- RUINS
- BUNKERS
- SANITARY FILL
- OXIDATION POND
- DISH—TYPE ANTENNA
- VERTICAL MINE SHAFT
- PIPELINE
- SMALL CEMETERY
- TRAILER LOCATION
- WATER TANK
- PUMPING STATION
- SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 I

CONTOUR INTERVAL 20 METERS
SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2655 III	2655 II	2755 III
2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III

NON-URBAN CULTURE FEATURES

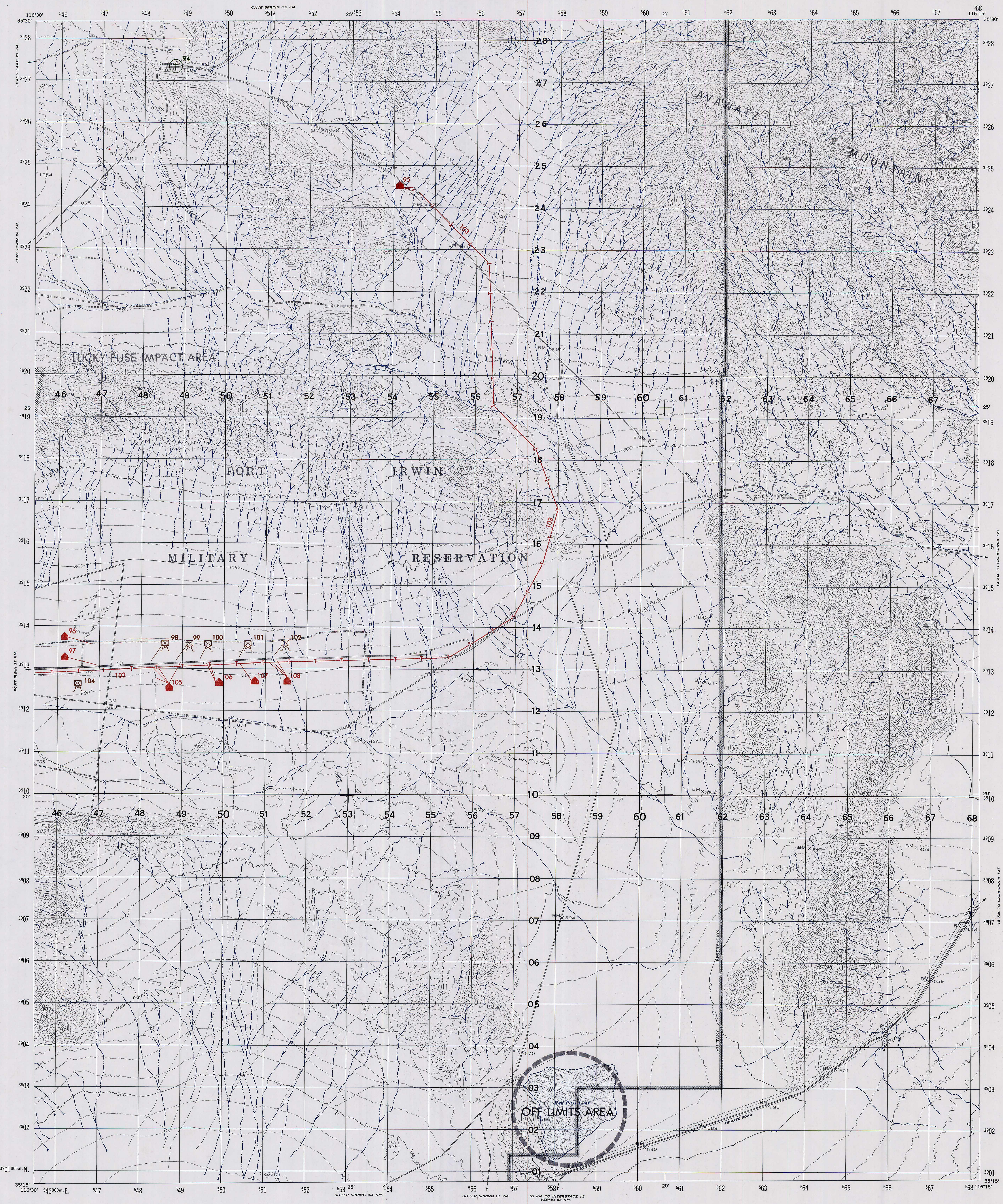
- WALL
- BUILDING
- RADIO TOWER
- MICROWAVE TOWER
- POWER SUBSTATION
- TOWER, USE UNKNOWN
- MONUMENT
- POWER LINE
- TELEPHONE LINE
- ABANDONED AIRSTRIP
- AMMUNITION BUNKER
- TOWERS, LOOKOUT, GUARD, FIRE
- RUINS
- BUNKERS
- SANITARY FILL
- OXIDATION POND
- DISH—TYPE ANTENNA
- VERTICAL MINE SHAFT
- PIPELINE
- SMALL CEMETERY
- TRAILER LOCATION
- WATER TANK
- PUMPING STATION
- SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 IV



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SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

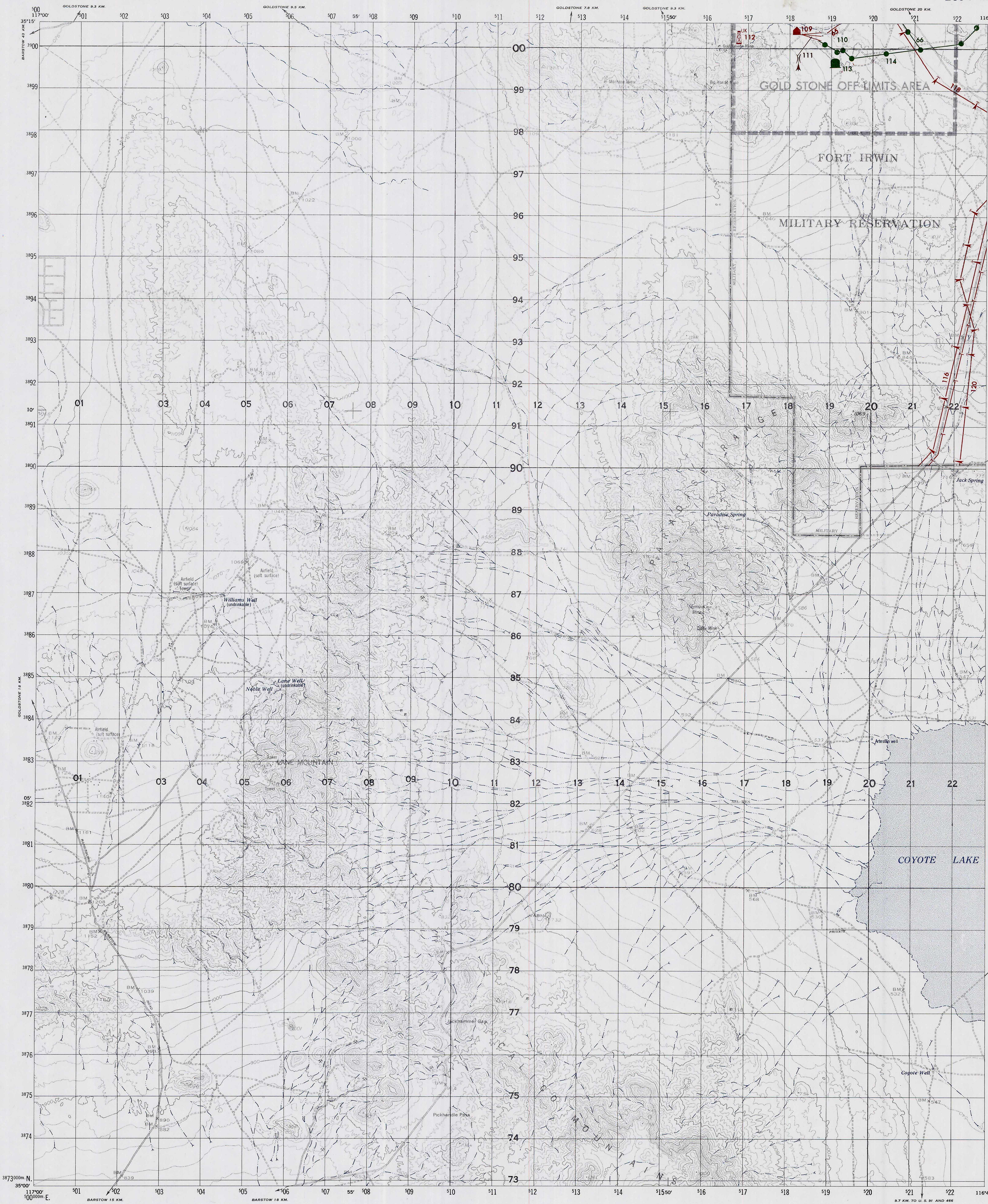
2655 II	2755 III	2755 II
2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II

NON-URBAN CULTURE FEATURES

WALL	MONUMENT	RUINS	PIPELINE
BUILDING	POWER LINE	BUNKERS	SMALL CEMETERY
RADIO TOWER	TELEPHONE LINE	SANITARY FILL	TRAILER LOCATION
MICROWAVE TOWER	ABANDONED AIRSTRIP	OXIDATION POND	WATER TANK
POWER SUBSTATION	AMMUNITION BUNKER	DISH—TYPE ANTENNA	PUMPING STATION
TOWER, USE UNKNOWN	TOWERS, LOOKOUT, GUARD, FIRE	VERTICAL MINE SHAFT	SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



CONTOUR INTERVAL 20 METERS
SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2554 I	2654 IV	2654 I
2554 II	2654 III	2654 II
2553 I	2653 IV	2653 I

NON-URBAN CULTURE FEATURES

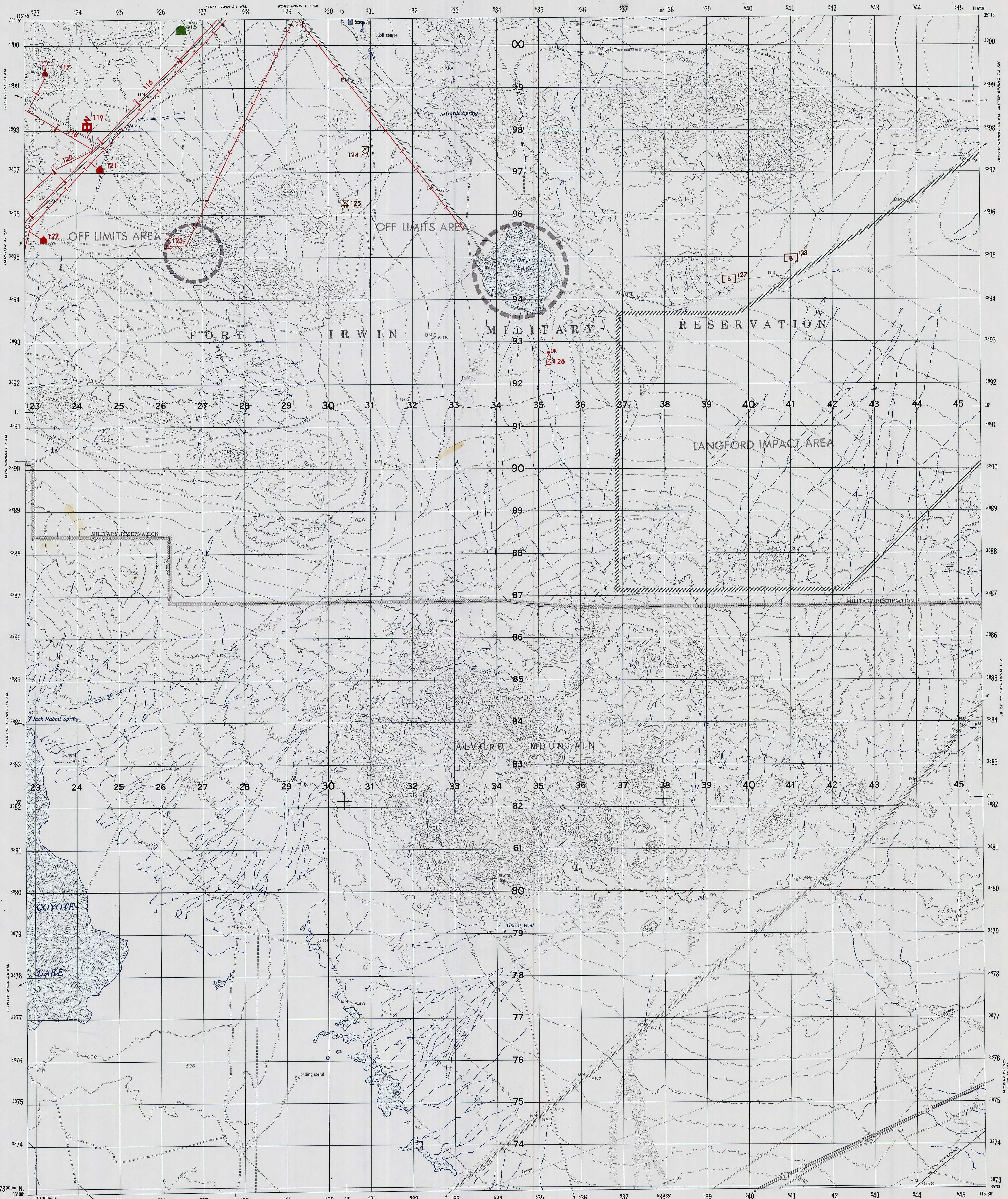
W WALL	MONUMENT	RUINS	PIPELINE
BUILDING	POWER LINE	B BUNKERS	SMALL CEMETERY
RADIO TOWER	TELEPHONE LINE	SF SANITARY FILL	TRAILER LOCATION
MICROWAVE TOWER	ABANDONED AIRSTRIP	OX OXIDATION POND	WATER TANK
POWER SUBSTATION	AMMUNITION BUNKER	DISH—TYPE ANTENNA	P PUMPING STATION
UK TOWER, USE UNKNOWN	TOWERS, LOOKOUT, GUARD, FIRE	VERTICAL MINE SHAFT	SD SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2654 II



CONTOUR INTERVAL 20 METERS
SUPPLEMENTARY CONTOURS 10 METERS

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ADJOINING SHEETS

2654 IV	2654 I	2754 IV
2654 III	2654 II	2754 III
2653 IV	2653 I	2753 IV

NON-URBAN CULTURE FEATURES

- WALL
- BUILDING
- RADIO TOWER
- MICROWAVE TOWER
- POWER SUBSTATION
- TOWER, USE UNKNOWN
- MONUMENT
- POWER LINE
- TELEPHONE LINE
- ABANDONED AIRSTRIP
- AMMUNITION BUNKER
- TOWERS, LOOKOUT, GUARD, FIRE
- RUINS
- BUNKERS
- SANITARY FILL
- OXIDATION POND
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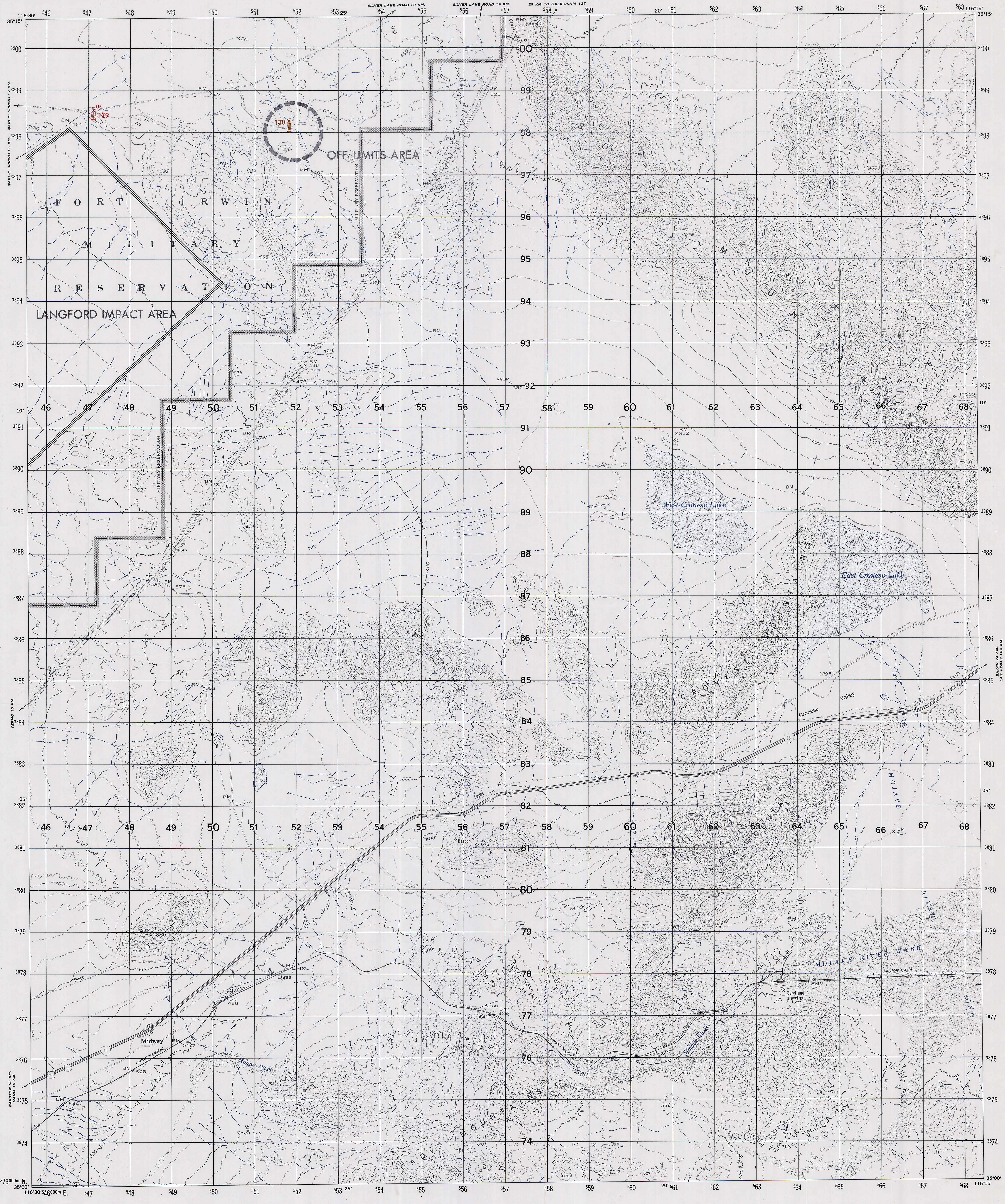
- PIPELINE
- SMALL CEMETERY
- TRAILER LOCATION
- WATER TANK
- PUMPING STATION
- SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS

CALIFORNIA 1:50,000

SHEET 2754 III



CONTOUR INTERVAL 20 METERS
SUPPLEMENTARY CONTOURS 10 METERS

Scale 1:50,000

1000 500 0 1000 2000 3000 4000 5000 Meters

1 ½ 0 1 2 3 Statute Miles

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ADJOINING SHEETS

2654 I	2754 IV	2754 I
2654 II	2754 III	2754 II
2653 I	2753 IV	2753 I

NON-URBAN CULTURE FEATURES

- WALL
- BUILDING
- RADIO TOWER
- MICROWAVE TOWER
- POWER SUBSTATION
- TOWER, USE UNKNOWN
- MONUMENT
- POWER LINE
- TELEPHONE LINE
- ABANDONED AIRSTRIP
- AMMUNITION BUNKER
- TOWERS, LOOKOUT, GUARD, FIRE
- RUINS
- BUNKERS
- SANITARY FILL
- OXIDATION POND
- DISH—TYPE ANTENNA
- VERTICAL MINE SHAFT
- PIPELINE
- SMALL CEMETERY
- TRAILER LOCATION
- WATER TANK
- PUMPING STATION
- SEWAGE DISPOSAL PLANT

Note: Number refers to entry in table

III. OFF POST FEATURES

A. AIRFIELDS

I. NAME, LOCATION, TYPE, AND CLASSIFICATION.

1. Name: Barstow-Daggett Airport
2. UTM Grid Coordinate: NJ1956
3. Type: Airport
4. Classification: Barstow—Daggett is a civilian airport under the direction of the San Bernadino County Department of Airports. However, the airport also serves the U.S. Marine Corps Supply Center at Yermo, California.

II. ELEVATION AND STATUS.

1. Elevation: 587.4 m (1,927 ft) above mean sea level.
2. Status: Operational

III. RUNWAY DESCRIPTION.

1. Longest runway:
   a. Dimensions: 45.7 m x 1950.7 m (150 ft x 6400 ft)
   b. Azimuth: 070° - 250°
   c. Runway weight bearing capacity:
      Single wheel - 105,000 lbs.
      Dual - 170,000 lbs.
      Dual tandem - 320,000 lbs.
   d. Surface material and condition: surface is asphaltic concrete and is in good condition.

2. Other runways:
   a. Dimensions: 30.5 m x 1674.6 m (100 ft x 5494 ft)
   b. Azimuth: 030° - 210°
   c. Runway weight and bearing capacity:
      Single wheel - 68,000 lbs.
      Dual - 105,000 lbs.
      Dual tandem - 190,000 lbs.
   d. Surface material and conditions: surface is asphaltic concrete and is in good condition.

IV. TAXIWAY, PARKING APRON, AND HARDSTAND AREA DESCRIPTION.

1. Taxiway dimensions:
   a. 15 m x 305 m (50 ft x 1000 ft)
   b. 15 m x 497 m (50 ft x 1630 ft)
   c. 15 m x 85 m (50 ft x 280 ft)
   d. 15 m x 85 m (50 ft x 280 ft)
2. Taxiway load capacity:
   a. T-1: S - 68,000 lbs, D - 105,000 lbs, DT - 190,000 lbs.
   b. T-3: S - 65,000 lbs, D - 100,000 lbs, DT - 180,000 lbs.
   c. T-4: new taxiway, no reliable information available.
   d. T-5: new taxiway, no reliable information available.
3. Taxiway surface material:
   a. T-1: asphaltic concrete, 10 cm (4 inches) on 15 cm (6 inches) base.
   b. T-3: asphaltic concrete, 5 cm (2 inches) on a 20 cm (8 inches) base.
   c. T-4: concrete, no other surface data available.
   d. T-5: concrete, no other surface data available.
4. Parking area of aprons:
   a. Apron A-1 (run-up area) - 1,858 m² (20,000 ft²)
   b. Apron A-2 - 60,385 m² (650,000 ft²)
5. Load capacity for parking area, apron and hardstands:
   a. Apron A-1 - S - 30,000 lbs, D - 65,000 lbs, DT - 90,000 lbs.
   b. Apron A-2 - S - 30,000 lbs, D - 65,000 lbs, DT - 90,000 lbs.
6. Surface material of Aprons:
   a. Apron A-1 - concrete
   b. Apron A-2 - concrete

V. BUILDING DESCRIPTION.

1. Number of hangers: 4
2. Dimensions: all four hangers are 12.2 m x 411.5 m (40 ft x 1,350 ft)
3. Construction material: all hangers are wood frame.
4. Maintenance facilities:
   a. Welding Shop
   b. Painting Shop
   c. Paint Bake Shop
   d. Plant Maintenance Shop
5. Administration and terminal buildings:
   a. Administration office - 316 m² (3,400 ft²). There is no control tower in operation. A Flight Service Station for advisories is on the airport.
6. Other buildings:
   a. Security and personnel building - 67 m² (720 ft²)
   b. Construction material: wood frame

VI. POL FACILITIES.

1. Type of fuel, storage, and dispensing facilities:
   Fuel facilities consist of three underground aviation gasoline tanks: 37,854 L (10,000 gal) of 100 octane; 22,712 L (6,000 gal) of 80 octane, and one 37,854 L (10,000 gal) tank that is unused. No jet fuel is stored at Barstow-Daggett. Jet fuel is available at Apple Valley 53 km (33 miles) SW of Barstow-Daggett. There are no fuel trucks available.

VII. NAVIGATIONAL AIDS.

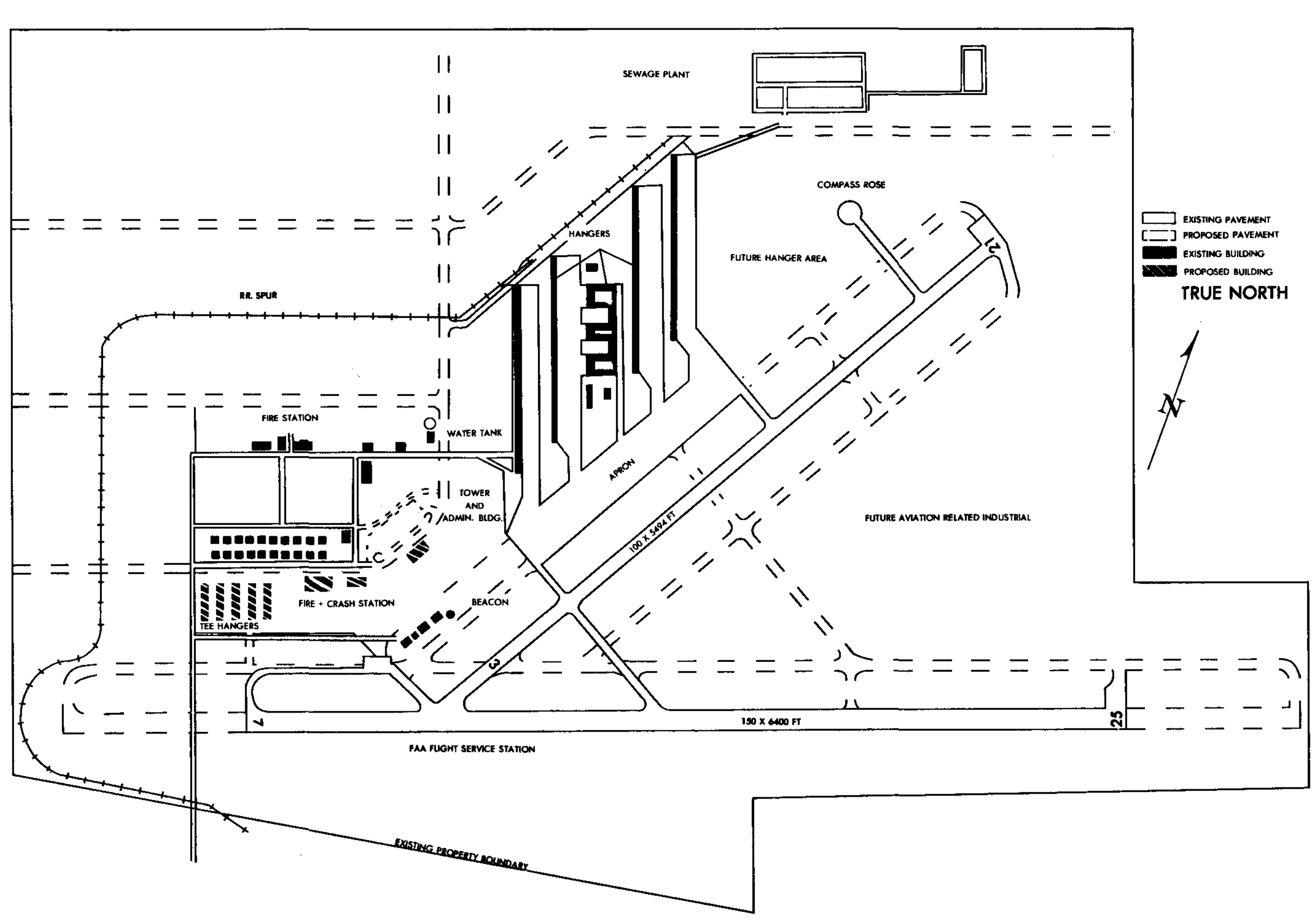
1. Control tower: There is no control tower in operation, only advisory information from the FAA flight service station on the airport.
2. Navigation: A VOR on the approach to runway 21 is the only instrument navigational aid at Barstow-Daggett. A rotating beacon is operated dusk to dawn.
3. Lighting of runways, taxiways:
   a. RW 3/21 - medium intensity runway lights.
   b. RW 7/25 - medium intensity runway lights.
   c. Taxiways: all taxiways are boardered with the standard blue taxiway lights.

VIII. REMARKS.

In the summer of 1978, taxiway T-1 will be resurfaced and taxiway T-4 will be extended parallel to RW 7/25 to the approach end of RW 25. Both runways will be sealed in summer of 1978 as part of a state - approved overall project.

Approach restrictions exist on runway 3. Two towers 76 m (250 ft) above ground level are located at a solar plant on this approach.

BARSTOW—DAGGETT AIRPORT, DAGGETT, CALIFORNIA



B. URBAN AREAS

INTRODUCTION

Barstow, California (the only city which meets the criterion of the urban study) is located 212 km (132 mi) northeast of Los Angeles and 251 km (156 mi) southwest of Las Vegas. The Ft. Irwin contonment area is 56 km (35 mi) northwest of Barstow. State highways 247 and 58 and Interstate highways 15 and 40 all intersect at Barstow, which makes the city easily accessible to the larger metropolitan areas.

Barstow is a steadily growing community with plenty of room for expansion. Presently, the city supports six manufacturing plants and various nonmanufacturing businesses, which include Marine Corps Supply Center, Sante Fe Railroad, Goldstone Deep Space Communications Complex, and Ft. Irwin to name a few. An estimated total employment for Barstow in 1975 was 10,800 people.

BARSTOW, CALIFORNIA

GEOGRAPHIC COORDINATES: 34° 53' N. Latitude
117° 02' W. Longitude
UTM COORDINATES: NK2802

POPULATION

Barstow was incorporated in 1947. The first census was taken in 1950, in which 6135 residents were registered. By 1960, the population grew to 11,644 and the 1970 census indicated a population of 17,442. Official city estimates for the 1976 population showed an increase which totaled 18,622. The projected increase in population is 3 percent per year, and using this figure, the projected population for 1980 is 20,958.

HOUSING AVAILABILITY

In summation of the housing characteristics between the years 1950 and 1970, total housing units increased from 1826 units in 1950 to 5590 units in 1970. Two-thirds of the increase took place during the decade of the sixties, when 2023 housing units were built, representing a percentage increase of above 111 percent. Through the seventies the percentage increase has been about 45 percent, amounting to 1741 units.

Owner occupied units increased both in the number and the percentage of all units, changing from 85.0 percent in 1960 to 89.7 percent in 1970.

In 1970, there were 3918 occupied, single-family units. 1074 (27.7 percent) were occupied by renters. The percentage was much higher in 1960, with 40 percent of the same units renter-occupied.

As a result of the 1970 housing census, it was found that 2.7 percent of all housing was one year old or less. 14.6 percent was 2 to 5 years old. 79.3 percent of the housing in the City of Barstow was built between 1950 and 1970.

As of December 31, 1974, there were no private multiple-family housing starts. Some of the single family housing starts have not been absorbed by the market and are still unoccupied.

Mobile homes make up 6 percent of all the single family dwellings in Barstow. All mobile home units are occupied, but the mobile home spaces are not all occupied. The following is a list of the mobile home parks with their respective number of spaces and occupancies as of January 1, 1975.

NUMBER OF SPACES

Park Name	Total	Occupied
Cee Jays	42	31
College Heights	161	137
Leisure Homes	95	42
Mecca	106	88
Red Top	43	20
Desert Villa	65	59
Holiday Homes	180	154
Total	692	531

In March, 1975 a community profile was written from which the following information was extracted on housing availability, prices, and rentals. Rentals for one and two bedroom apartments and duplexes ranged between $90.00 to $150.00 per month. Rentals for two and three bedroom houses ranged between $125.00 to $225.00 per month. Sale prices of existing homes have ranged from $18,000 to $75,000 during 1974. There are 7 suburban residential areas within 19 km (12 mi) of Barstow offering homes priced from $18,000 to $75,000. Facilities for mobile homes are available at 9 mobile home parks.

Vacancy rates of housing units as of January, 1975, showed that of single-family units owned by the occupants, 3.0 percent were vacant. Multiple-family rental units had a 9.5 percent vacancy rate, and mobile homes were 2.0 percent vacant. The overall vacancy rate was 4.3 percent.

The general forecast for housing development in Barstow is a steady increase of middle income housing.

TABLE I

Type of unit	
Single-family	4156
Multiple-family	1174
Mobile Home	260
Total	5590

Owner occupied	
Single-family	2844
Multiple-family	81
Mobile home	245
Total	3170

Renter occupied	
Single-family	1074
Multiple-family	862
Mobile home	15
Total	1951

TABLE II

New housing started in Barstow between the years 1970 - 1974.	
Total units	220
Single-family	120
Multiple-family	100
Demolitions	41

Figures for the previous table were taken from 'Housing Analysis for the City of Barstow' written by Economics Research Associates, 1975.

MEDICAL FACILITIES

Barstow has 1 general hospital that has a bed capacity of 56. There is one small convalescent hospital but bed capacity is unknown. Barstow also has 5 pharmacies, a clinical laboratory, a medical physician's building, a mental health clinic, ambulance, and air ambulance service. In the City of Barstow, there are 17 full-time physicians and surgeons, 7 dentists, 3 optometrists and 6 chiropractors.

Doctor/population ratio - 1/1095
Dentist/population ratio - 1/2660

EDUCATIONAL FACILITIES

The City of Barstow has a unified school district which incorporates several small schools in surrounding communities. The following list gives associated grades, capacity, and current enrollments taken from attendance records dated March 18, 1977.

ELEMENTARY SCHOOLS

* Baker/Kelso: grades K-8. Capacity 150. Current enrollment 116.
Cameron: grades K-6. Capacity 690. Current enrollment 565.
Crestline: grades K-6. Capacity 450. Current enrollment 484.
Daggett: grades K-8. Capacity 450. Current enrollment 135.
Henderson: grades K-6. Capacity 450. Current enrollment 426.
Hinkley: grades K-8. Capacity 450. Current enrollment 328.
** Ingels: grades K-6. Capacity 300. Current enrollment 175.
Lenwood: grades K, junior 1st-6. Capacity 450. Current enrollment 313.
** McKinney: grades K-6. Capacity 390. Current enrollment 189.
Montara: grades K-6. Capacity 633. Current enrollment 514.
* Mt. Pass: grades K-8. Capacity 120. Current enrollment 85.
Newberry: grades K-8. Capacity 180. Current enrollment 183.
Skyline: grades K-6. Capacity 420. Current enrollment 326.
Thomson: grades K-6. Capacity 450. Current enrollment 362.
Yermo: grades K-8. Capacity 630. Current enrollment 295.
Total enrollment for district elementary schools - 4496.

JUNIOR HIGH SCHOOLS

Barstow Junior High: grades 7 and 8. Capacity 1080. Current enrollment 823.
** Pitcher Junior High: grades 7 and 8. Capacity 450. Current enrollment 346.
Total enrollment for district junior high schools - 1169

HIGH SCHOOLS

* Baker High School: grades 9-12. Capacity 60. Current enrollment 51.
Barstow High School: grades 9-12. Capacity 2040. Current enrollment 1308.
Central High School: grades 9-12. Capacity 170. Current enrollment 346.
** JFK High School: grades 9-12. Capacity 1300. Current enrollment 1079.
Total enrollment for district high schools - 2784
Total enrollment for district in all categories - 8449

* Incorporated into new districts
** Schools scheduled to close

HIGHER EDUCATION

Barstow College: Established in September, 1959, the college operates on a two-year program using the quarter system. Barstow College is accredited by the Western Association of Schools and Colleges. Enrollments generally average about 2000 students. Athletic facilities are provided by Barstow High School.

Other facilities include a career center for handicapped students and four private elementary schools.

RECREATIONAL FACILITIES

The residents of Barstow have access to a significant range of leisure service facilities. This is especially true if recreational areas are viewed in a regional context with such areas as Big Bear Lake in the San Bernardino mountains, and the extensive facilities of Los Angeles, which include Disneyland, professional spectator sports, and ocean beaches within an easy one-day driving range. Within just a few hours drive are both the San Gabriel and San Bernardino mountains with excellent ski slopes.

The following is a list of the recreational facilities available in the Barstow Park and Recreation District:

PARK CATEGORY	PARK NAME	ACREAGE
Play lot/Mini Park	Harvard Street Park	1.0
	Waterman Park	0.6
	'H' Street Park	2.5
Neighborhood Parks	Lenwood Park	2.53
	Skyline North	5.0
	Sturnade Park	10.35
	Cameron Park	3.2
	Pitcher Jr. High	5.0
	Lilian Park	3.68
	Jasper Park	2.04
	Daggett Airport	7.0
Community Parks	Park	35.0
	Dana Park	8.83
	Community Center	10.0
Additional Facilities	District Lighted Field	8.04
	Museum	0.7
Total Acreage		105.47

The community also has 2 theaters, 2 swimming pools, 1 bowling alley, 1 roller rink, 1 18 hole municipal golf course, 13 tennis courts, and 1 recreational center with gym, weight room, arts and crafts room, handball courts, and sauna baths. Plans for a proposed community park have been made to add approximately 40 acres to the total recreational areas in Barstow. This proposed park would include an outdoor theater, sheltered picnic areas, fire ring amphitheater, hiking trails, and gardens. Also proposed is a solar heated swimming pool to be located near the existing community center.

UTILITIES AND FACILITIES

ELECTRIC POWER

Southern California Edison Company is the electrical power supplier for Barstow and surrounding area. Steam generation stations located throughout the Southern California area and neighboring states provide the source of electrical energy. The system is designed on a grid basis, with many varied sources of supply. The majority of source power is from a gas and oil fired generating station.

Records on specific residential electrical demands are not maintained. Daily records are maintained for the overall system of the service territory, in which the prime interest in a given area lies in the monthly substation loading.

A five year load forecast on substations serving this area is maintained to determine with some degree of accuracy the need to increase substation capacity. Presently, the growth pattern in the Barstow area is 3 to 4 percent per year, and does not indicate a need to increase the capacity of any substations.

Although the electrical power provided by Southern California Edison is adequate for present needs, Barstow may be the site of a 10-Megawatt Solar Power Plant. In September, 1976, Southern California Edison Company, the Los Angeles Department of Water and Power, and the California Energy Resources Conservation and Development Commission proposed a partnership to the Energy Research and Development Administration to design, construct and operate a solar power plant.

The project is based on the assumption that the California consortium for Barstow is selected by the ERDA as the best site. If Barstow is selected, the plant would be located 19 km (12 miles) southeast of Barstow with a net electrical output of 10-megawatts. Entire pilot plant cost has been estimated at $100 million. Construction would be complete in October, 1980, and plant operation would begin in December, 1980.

The proposed pilot plant will utilize the central receiver concept. Sunlight is reflected off a group of tracking mirrors to concentrate on a receiver/boiler that produces steam to power the turbines that generate electricity.

SEWAGE DISPOSAL

The existing waste treatment plant for the City of Barstow was constructed in 1968, and was designed to meet the discharge requirements of the Lahontan Regional Water Quality Control Board dated October, 1966. The plant once provided only primary treatment with lagoon stabilization and sludge incineration. At the time, disposal of effluent was by means of evaporation and percolation.

New discharge requirements passed in June, 1970, call for an effluent quality which is obtainable only through secondary treatment, and in, additionally, requires that the effluent quality prescribed be met before the effluent percolates to the ground water level.

The existing plant, with modifications for secondary treatment, is designed for an average daily flow of 17 MLD (4.5 mgd), with a peak flow of 29 MLD (7.65 mgd), and a minimum nighttime flow of 1.1 MLD (0.3 mgd). These design flows are adequate for serving a population of between 30,000 and 45,000 people. Presently, the plant is operating well within these design flows.

HEATING FUELS

Natural gas is distributed through the Barstow area by the Southwest Gas Corporation. Pacific Gas and Electric is responsible for the transmission of natural gas from the El Paso Natural Gas Company from the Colorado River to the Bay Area and back down to Barstow.

The projected total demand for Barstow in 1978 is 1,351,129 thousand cubic feet. Specific users and projected 1978 demands are listed below.

1. Residential, air conditioning and small commercial businesses - 693,021 MCF (thousand cubic feet).
2. Heating only - 25,000 MCF.
3. Large commercial businesses - 272,108 MCF.
4. Interruptible (excluding military) - 111,000 MCF.
5. Gas engine (mostly water pumps) - 60,000 MCF.
6. Military (uninterruptible) - 77,000 MCF.
7. Military (interruptible) - 113,000 MCF.

Gas reserves and transmission capabilities are totally adequate to meet present demand. There are no projected demands for subsequent years beyond 1978.

WATER SUPPLY

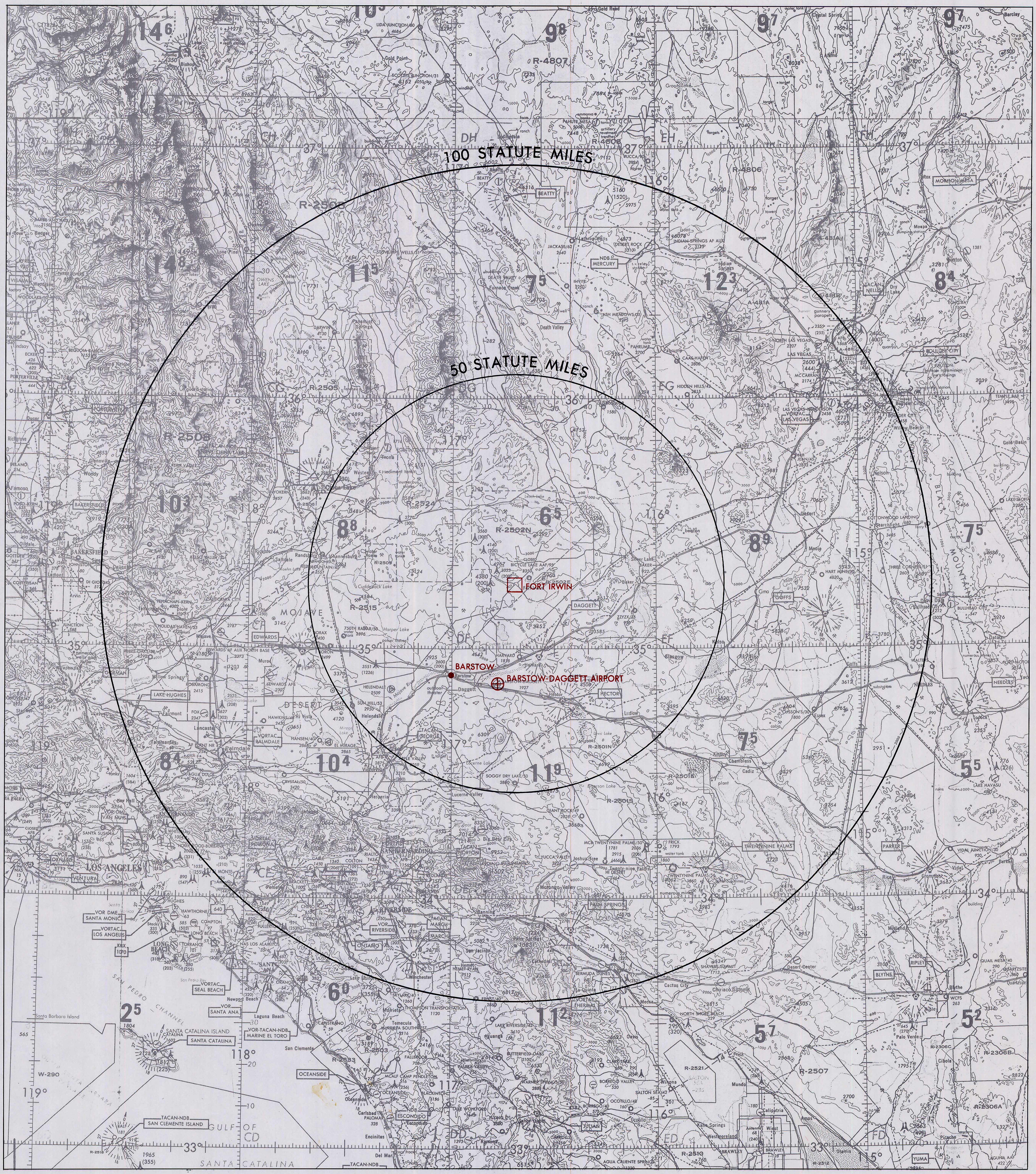
Barstow is situated in the Mojave Water District. The water supply to Barstow is controlled by the Southern California Water Company, 830 East Williams St., Barstow, California.

The entire water supply for the city is dependent upon ground water which is pumped from two well fields. The Bradshaw well field has 9 well points, of which 98 percent of the water recovered goes to Barstow. The Arrowhead well field has 3 wells, all of which are dedicated to Barstow. Resevoir capacity in above-ground storage tanks is 11.4 million liters (3 million gal).

The City of Barstow has an average consumption rate of 25.7 MLD (6.8 mgd), or approximately 1325 L (350 gal) per day per person. Barstow is presently dependent upon spring rains to reclaim approximately 200 acre-feet per year to the recharge area. Under normal circumstances, well draw-down is 2.1 m (7 ft) per year, which gives an adequacy rate of 10 years. However, with the growing population of Barstow, the recharge rate cannot keep up with demand, and Barstow faces a serious water shortage within the next decade, if supplemental means of water supply are not found.

Future plans to alleviate water shortages are under consideration in the form of two proposals. One is called the Mojave Water Project involving an aqueduct, but details of the project are unknown. The second proposal is a pipeline from Helendale, California, on the Mojave River about 30 miles SW of Barstow. This pipeline would connect the two communities and bring in water to Barstow from the upper Mojave River.

FORT IRWIN, CALIFORNIA
TERRAIN ANALYSIS



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OFF-POST FEATURES

- CANTONMENT AREA
- URBAN AREA
- AIRFIELD

Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texas 76544. Cartographic and reproduction support provided by the 30th Engineer Battalion (Topographic) (Army), 584th Engineer Company (Cartographic), Ft. Belvoir, Virginia 22060, under the direction of the Terrain Analysis Center, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Virginia 22060. June 1978.

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45. Mr. Johnny S.O. Tan, Asst. City Engineer, City of Barstow, CA. 27 April 1977.
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53. CPT A.T. Dye, Directorate of Facilities Engineering, Ft. Irwin ,CA.
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